

# HP Professional

THE MAGAZINE FOR THE BUSINESS & PRACTICE OF HEWLETT-PACKARD COMPUTING

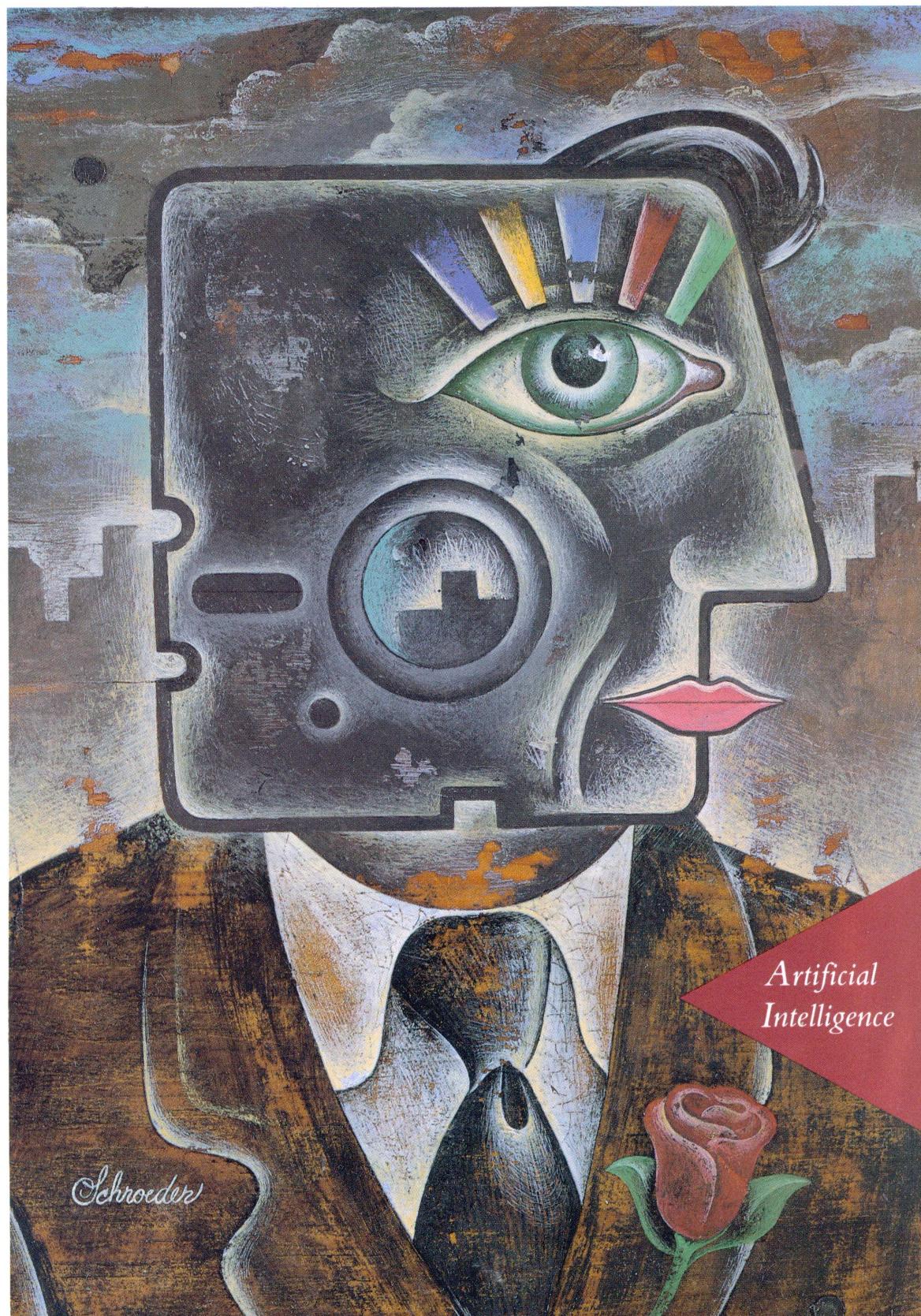
NOVEMBER 1987 ■ VOL. 1, NO. 6

- Knowledge-Based Systems
- Accounting Software Market Share
- Understanding Integer Keys



DEVELOPMENT

Planning  
Strategic  
Outlining



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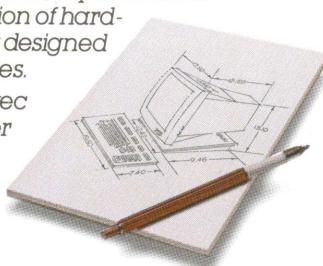


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# Does your HP3000 really support the LaserJet?

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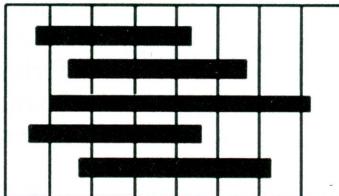
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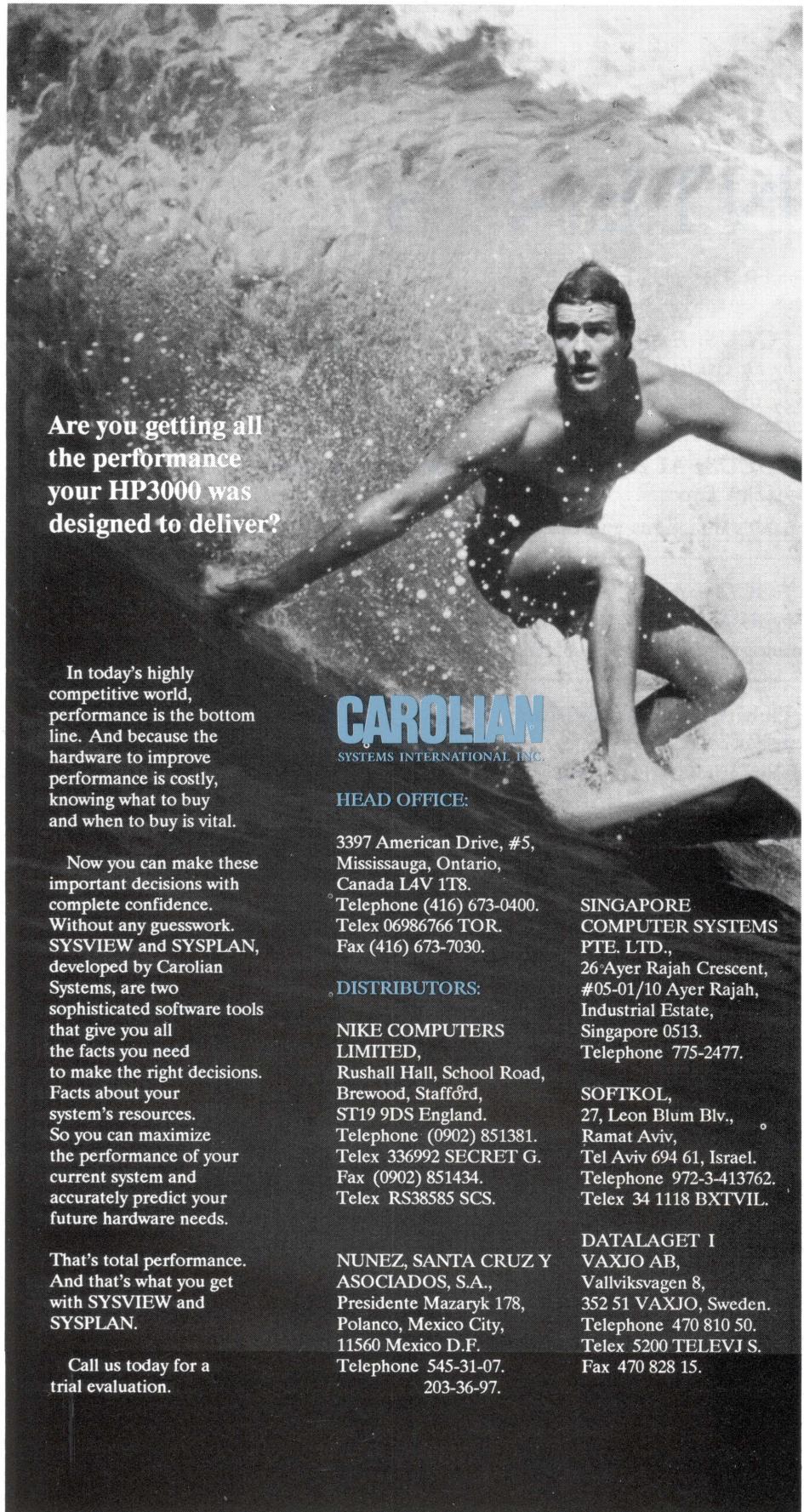
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This month's cover  
illustration was created  
by Michael Schroeder,  
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## SECTION 5: IMAGE DATABASE STRUCTURAL CHANGES

DBGENERAL's Section 5 permits any conceivable valid changes to be made simultaneously to the structure of an IMAGE or TurboIMAGE database. Hundreds of structural changes may be queued up in advance and, upon

execution, the database and all of its contents are transformed to the new structure—in a single pass. This method requires the minimum possible time and effort, and provides the greatest convenience for several reasons:

- Changes are queued up in shared access mode while users are accessing the database.
- All data is preserved in the transformation, including numeric fields whose data types are changed.
- Changes may be activated at any time when exclusive access to the database is available, either on-line or from a batch job.
- DBGENERAL can rename a field in a dataset but not in all its occurrences in the database, and can redefine a single field as multiple fields and properly reassign the data contained in it.
- All reblocking and pointer adjustment is done as necessary.
- Either DBGENERAL can be used to queue up the changes, or the changes can simply be made directly to the schema and the new schema can be fed into DBGENERAL as the blueprint for the new database structure.
- If several databases require the same structural changes, DBGENERAL can restructure all of them from one set of changes. And if the databases are located at different sites, each one can be given a common schema from which DBGENERAL can transform all the bases.
- The changes can be played out on a test database (which you can easily build with DBGENERAL's Section 6 Copying Functions.)

### ITEM CHANGES

Permits you to add new items to the database; change the type, length, or table size of existing items; move items to new positions in the item list; delete items from the database; and rename items currently in the database. In changing an existing item, all live data is preserved, and data type conversions are supported.

### DATASET CHANGES

Allows you to add new datasets to the database; move datasets to new positions in the dataset list; delete datasets from the database; rename existing datasets; and change a manual master dataset into an automatic master and vice-versa.

### SET-ITEM CHANGES

Lets you add new items into a dataset; move items to new positions in the dataset item list; and delete items from a dataset.

DBGENERAL has been changing the structures of IMAGE databases since 1984 and TurboIMAGE databases since March 1986. It is tried-and-true at hundreds of HP3000 sites, time after time, on both IMAGE and TurboIMAGE databases.

We provide technical support 24 hours a day, 7 days a week, on everything from structural problems to performance concerns to broken chains, defective keys, invalid bit maps, and erroneous user labels.

And this is only Section 5 of DBGENERAL—there are

### PATH CHANGES

Permits you to add, change, and delete paths between master and detail datasets; allows an unsorted path to be removed or included; lets an item in a master dataset be defined as the search item; and permits the primary path in a detail dataset to be redefined.

### PASSWORD CHANGES

Allows additions, changes, and deletions of passwords to be made, thereby maintaining proper security levels through timely alterations of passwords.

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Allows an entire database to be reblocked to a new block size, and permits reblocking of individual datasets.

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stop  
asking*

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# Seamlessness

---

The first thing that is abundantly clear is that MPE-XL cannot be all things to all men. It is a relatively mature transaction-processing system that delivers rather superlative performance in transaction-oriented applications. It is not a general timesharing system.

There are whole classes of applications that do not fit well into MPE. In some respects, MPE has defined the type of customer that has ended up with a 3000. Granted that one can find applications of almost every type running in the environment, many have been "shoe-horned" in. One example is that there is only one third-party host-based word processing system.

Enter UNIX. The truth is that in a few years, there will be only three classes of computer users: those still running the babel of IBM O/Ss, VMS users and UNIX users. This will not come to pass because of the overwhelming superiority of UNIX (it ain't!), but simply because its ubiquity has forced everyone who cannot afford to develop a VMS (everyone but DEC) to band together under its "standard(s)."

Someone recently said that UNIX actually is a plot to hand over the remainder of the U.S. computing industry to the Japanese. Once there is a true standard operating system, then no one can surpass them at volume manufacturing.

Recently, HP announced the beginnings of "commercial" UNIX. Actually, there is no such thing. There is only UNIX. There are a few flavors, but they are tending to converge possibly in a standard called POSIX. There are a few truly fine user interfaces that make it possible to write and actually *run* applications in an atmosphere devoid of the nearly meaningless cryptic gibberish of the standard shell. HP contends that it is offering "commercial" UNIX merely as a platform for third parties to offer their packages. I contend that the writing is writ large upon the wall.

How else can HP create a seamless product line and a seamless corporate identity? MPE can be relegated to a solution for those requiring high-volume transaction processing (and supported forever).

My perception of the company is that it has created a San Andreas fault right down the middle between commercial and technical. The commercial side is insulated from the availability of workstations. Physically and electrically identical machines get different name tags depending on which side of the fault they are sold. These divisions, time-honored though they may be, are counterproductive in a market that demands seamlessness. UNIX will heal most of that fault. Artificial distinctions are just that: fake.

A handwritten signature in black ink, appearing to read "R. D. Miller". The signature is fluid and cursive, with a large, stylized 'R' at the beginning and a 'Z' shape at the end.

# A Programmer Calls His Dog.

WITH COBOL

```
IDENTIFICATION DIVISION.  
PROGRAM-ID. CALLDLG.  
ENVIRONMENT DIVISION.  
SELECT ANIMALS  
    ORGANIZATION IS INDEXED  
    ACCESS IS DYNAMIC  
    KEY IS ANIMAL-TYPE  
    ASSIGN TO BEASTS.  
DATA DIVISION.  
FD ANIMALS  
    RECORD CONTAINS 16  
    CHARACTERS  
    DATA RECORD IS ANIMAL-REC.  
01 ANIMAL-REC.  
    03 ANIMAL-TYPE PIC X(8).  
    03 ANIMAL-NAME PIC X(8).  
PROCEDURE DIVISION  
START.  
    OPEN INPUT ANIMALS.  
    MOVE 'DOG' TO ANIMAL-TYPE.  
    READ ANIMALS INVALID KEY  
        DISPLAY 'BAD ANIMAL'  
        LINE 10 POS 1.  
    CALL-SPOT.  
        DISPLAY 'HERE' LINE 10 POS 1.  
        DISPLAY ANIMAL-NAME HIGH  
        LINE 10 POS 16.  
    CLOSE ANIMALS.  
STOP RUN.
```

WITH SYSTEM Z

Here, Spot.

## Is System Z 4GL COBOL?

System Z allows you to combine familiar COBOL syntax with ultra high-level keywords that define entire processes. Development time is cut to a fraction. Z lets you concentrate on the functionality of the program rather than the tedious definitions and procedures.

ZBASE includes a database manager with relational functions and a data dictionary that interacts with the compiler. The need for file or data definitions in the program is totally eliminated. A powerful editor is built into the Z compiler so that errors are identified and explained as you create them.

ZIP, a utility of System Z, allows you to develop queries, menus and reports with no programming knowledge. However, for the more experienced user, the source code generated by ZIP can be enhanced or modified for more complex applications.

## Eliminate Machine Dependence

Programs developed with System Z are not dependent upon the hardware or operating system they were developed on. The executable code can be "copied" to other systems with no change or recompiling. For example, you might have a program developed under UNIX and then decide to install it on a DEC VAX under VMS or a PC under DOS. Graphics, function keys and other conventions previously accepted as "machine dependent" are portable.

## Performance + Productivity + Portability

System Z cuts development time by 90% without paying the price of slower response times and greater memory and disk requirements. Incredible as it seems, Z programs actually run **faster** than those developed with BASIC or COBOL and require only a fraction of the resources that third generation languages need.

Call or write now for more information.

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## LETTERS

### Behind Type-Ahead

I just finished reading the editorial, "It's Time to Grow," in the September 1987 issue. I found the second to last paragraph amusing. I worked on a number of different systems, long before word processing came to computers, and they all used type-ahead.

I asked HP for type-ahead back in 1980. HP's response to my requests for type-ahead, sometimes even through user group meetings and the president of the HP International Users Group, has consistently been, "You're the first person ever to request it."

I also asked for other innocuous changes:

- Itemized maintenance bills with serial numbers.
- Record locking for KSAM.
- Better peripheral support for TDP/3000.

HP consistently responds with the aforementioned quote. So, while I find your idea of telling HP our wants to get results, I find the idea terribly naive. My response to HP's repeated denials to the very existence of these and other like-minded problems is, "I'll vote in the future with my dollars." In other words, future purchases will be non-HP wherever possible.

**Anthony M. Keller**  
Reed College  
Portland, OR

### Product Line Fatalities

I have read with interest my first two copies of *HP PROFESSIONAL*. It is refreshing to see someone take a strong interest in this market.

The article by Don Person in the August issue ("HP Says Goodbye to

Address letters to the editor to the *HP PROFESSIONAL* magazine, P.O. Box 445, Spring House, PA 19477-0445. Letters should include the writer's full name, address and daytime telephone number. Letters may be edited for purposes of clarity or space.

Apple II") was of particular interest to me. His insight and forward look at HP's approach to third-party hardware and software hopefully will be read by people within HP who can do something about these problems before any additional product line fatalities occur.

One thing missing in the announcement accompanying the article is what we at AMS consider the best method of moving to Rocky Mountain BASIC, our Series 80 to 300/200 TRANSLATOR. This is the most comprehensive automated translation program we know of, covering over 90 percent of the Series 80 BASIC keywords including ROMs and Binaries.

While this product has been listed in the HP PLUS catalogs since their inception, it was unknown to the folks at Corvallis. Perhaps this points out additional problems with HP's Third-Party Program.

Thank you again for your fine publication and keep up the good work.

**Greg Lawson**  
Advanced Microsolutions (AMS)  
Redwood City, CA

### To Halt :Readers :Letter

Try this LOGO program:

```
TO HALT :READERS :LETTER
READ OPINION
THINK

TO READERS
MAKE "OPINION RC
IF :OPINION = THINK [STOP]
IF :OPINION = UNTHINK [LETTER]

TO LETTER
PRINT [DEAR SCHOOL BOARD,
STOP LOGO]
PRINT [SIGNED, UNTHINK]
```

Halt those letters recommended by Cliff Lazar in "Opinion" in the September issue of *HP PROFESSIONAL* until you have considered some more points.

Point #1 to consider is the age of the children. Does he mean all children from age three and up should never see LOGO? Educational techniques vary with the age and stage of development, both physical and mental.

For instance, a three-year-old can learn more than we usually ascribe to a three-year-old if he is presented with material that he can control both mentally and manually. Hand development traditionally has slowed the reading/writing development because the hands could not manipulate a pencil. Typewriters with their many moving parts were too breakable to use. The computer keyboard is quite sturdy and can take a great deal of hard knocks.

Even before the three-year-old knows the alphabet, he can find FD 90



# A TO D SIMULTANEOUSLY

**Infotek introduces AD300—the first 32-channel analog/digital converter board for HP 9000 Series 200/300 with four-channel simultaneous sampling.**

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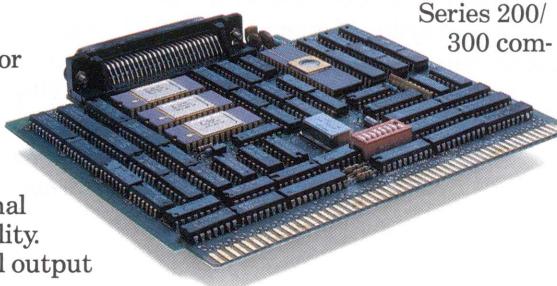
- HP GPIO protocol—no special software—for fast, easy programming.
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300 com-

puters, and costs many thousands of dollars less than stand-alone converters. Its microprocessor control and 64K on-board buffer reduce the load on the host computer—while GPIO protocol compatibility and a simple, three-step programming procedure reduce the load on the operator!

Here is the quality and performance you expect from Infotek—world leader in HP enhancement products. Call or write today for more information to Infotek Systems, 1045 S. East Street, Anaheim, California 92805-8508, (714) 956-9300, (800) 227-0218, in California (800) 523-1682, TELEX 678870.



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Easy to Learn  
Easy to Install  
Easy on Your Budget

Help your people communicate more and interrupt less by sending messages on-line using XPRESS.

XPRESS is perfect for those urgent operational inquiries that add so much to your telephone and telex bills. XPRESS makes it a snap to send a message to another employee, even one located in a distant time zone. A buyer in Cincinnati can switch quickly into XPRESS, send a query to a shipping clerk in the Cleveland warehouse, and be back in his application program seconds later. With inexpensive serial printers in your departments, XPRESS allows you to send 'telexes' to people who lack CRTs.

### Simple but Powerful

No need for expensive training - you can have people sending and receiving messages the first day, writing automated reminders the second day, and posting news flashes on the bulletin board by the third day.

### Continually Enhanced

1985: multi-cpu mail networks. 1986: distribution lists. 1987: automated pickup and delivery of mail for PC users.

XPRESS works on all versions of MPE, including the new Spectrum MPE/XL. XPRESS does not require any special type of CRT. XPRESS is \$3000, including one year of service. Pleasant Surprise: extra CPUs are only \$600 each. No charge for trial.

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Holland 4242.15655 South Africa 021 61 9001  
Sweden 08.35.4666 Switzerland 031.46.1664

ENTER 224 ON READER CARD

RT 90 <return> four times to make a square. If that is too much, it can be simplified by the teacher programming for the child to press F 90 R 90 <RETURN>. Or, for two-year-olds, the key can be set to press F to see the turtle go forward a set amount, or even to press C to get a circle.

Now here is the miracle part: If a mistake is made and the square does not appear, a small group of children can start the debugging part. What went wrong? What can we do? This is analytical thought. Piaget in his famous child development theories says that children do not have analytical thoughts until they are seven years old. However, we know that these theories do not mean all children will start being analytical at seven or that no child will be analytical until seven. Seymour Papert, who developed LOGO from the forerunner of AI languages, theorizes children can be exposed to more analytical thought earlier and better through LOGO. What a civilization we could develop with more analytical citizens!

If the word "theory" bothers the reader in the above arguments, please recall that  $E=mc^2$  also is only a theory.

Point #2: You can see the logic that an algorithmic language like BASIC or PASCAL cannot be taught before a child reads well enough to substitute one set of symbols for another. Fourth grade could be the earliest that BASIC could be presented to an entire class. Valuable time is lost waiting that long.

Point #3: LOGO can be used more easily as a word processor that combines pictures with text than BASIC or PASCAL. Some fifth/sixth graders are taught at the beginning of the school year to use LOGO as a word processor and then are required to make group reports followed by tests of their material for the rest of the class to take. This uses computer programming in all subject matters.

If you say, "Why not just give them

a word processor and a language?" may I remind you that there usually is not enough money for most materials in the classrooms of America? Also, the above system makes programming a part of their life.

Point #4: At a recent lecture on AI languages attended by BASIC, COBOL, PASCAL, etc. programmers, I found I understood more than they did because of my knowledge of LOGO. They were having trouble making the jump from algorithmic languages to procedural languages. It was difficult for them to understand that the programmer could develop his own commands such as READERS or LETTER in the above program. Since LOGO is more analogous to human thought than equations in algorithmic languages, it seems that LOGO is an appropriate beginning for AI languages like PROLOG.

(Incidentally, the above program is unfinished because OPINION, THINK, UNTHINK have not been defined as commands. It will not run on your child's copy of LOGO. Can you finish the program?)

Point #5: I don't really think that everyone should learn LOGO before they learn any other language, but LOGO can be started at age three, or even two. If a child has only gained access to computers at age 10 or more, then, by all means, use other languages. Elementary school teachers teach all subjects to one class more often than not in our country. Not all will be good programmers, I agree. Specialized teaching generally starts in the middle schools. Certainly, other languages taught by experienced programmers should be taught. Not all people will become programmers, but most will come in contact with computers at their grocery stores, in their cars, at the bank, etc. Programmers will have to write foolproof programs for us, but it behooves the school systems to give a general background in programming to all. Why not start as young as possible with LOGO?

**Georgia Weatherhead  
Fairfax, VA**

## **Education Defense**

It is clear to me that Cliff Lazar ("Computer Fraud Upon Our Children," September 1987) has unpleasant memories of his scholastic experience and therefore is unable to view education objectively. His editorial labeling LOGO as "computer fraud" was really a thin disguise for a diatribe against all teachers and school administrators. His favorite adjective — first applied to classroom teachers who are forced to teach a subject they are not familiar with, and later to all teachers and administrators — is "pedantic." Such labels and generalizations, regardless of their target, constitute bigotry.

Mr. Lazar's attack on the LOGO language as a poor language for graphics totally misses the point. It is not the intent of an elementary school program to assist businesses and individuals to shop for the best software packages; it is to teach the concepts of algorithms and programming. Does he seriously wish to suggest that second graders be taught COBOL?

It is not important that LOGO is not a useful language. What is important is that it can be understood by a primary-aged child and that it provides practice and support for the concepts being taught. Mr. Lazar says, "Some, but not all, of our kids should get to do advanced programming." How does he propose to decide whose kids should?

Doesn't it make sense to allow younger kids to receive early exposure to a simplified programming environment so that their interest and aptitude for programming can be tried? Maybe then the children, along with their teachers and parents, will have a basis for their decisions concerning more advanced instruction.

The public is always making new demands on the public schools. People want their children to learn new technologies and subjects, and at the same

time they cry for a "return to the basics." Today's teachers are expected to teach the three Rs more thoroughly than they did 30 years ago, and to teach a wide variety of new subjects — technical, social and health-related — all in the same number of hours per day. Maybe the kids should go to night school! Mr. Lazar, like many people, says that "Teachers who don't program shouldn't teach programming." Will he quietly accept the tax increases necessary to populate our elementary schools with specialized faculty in a variety of subjects?

If children are being given programming assignments for which they don't have adequate keyboard time, then the problem is with scheduling, or with the shortage of computers in a district whose citizens won't agree to increased funding, or with conflicts with other academic or extra-curricular demands, not with the programming language being used. The confusion of several complex issues in an editorial that purports to deal with LOGO makes many of the arguments laughable. Did Mr. Lazar's paraplegic friend know how to develop an algorithm or program a computer after his 45-minute lesson on the use of a graphics software package? He seems to feel that only marketable skills (and programming languages) should be taught in elementary school. He remarks that using LOGO is a "skill that's in very low demand." I guess he wants Americans to be trained, not educated.

Finally, I would like to offer the general observation that teaching is a profession that ranks second only to coaching in the number of people who think they are more expert in its practice than the trained professionals. So many people are quick to condemn educational methods before they explore the reasons for their implementation, assuming that teachers are a bunch of idiotic tyrants who never considered the obvious issues. I have known a multitude of people who are expert in a technical subject, but couldn't teach it to Einstein. They can not express

themselves in terminology that is understandable to one who does not already know the subject. More important, they are not sensitive to the instructional needs of their students and do not understand the process of learning.

The limiting factor in being a good teacher, especially with young children, is the ability to teach, not knowledge of the subject. This is not to say that one can teach something he doesn't know, but simply that teaching skills are more difficult to obtain than elementary math skills, for instance. Good teaching is an art form, and to a great extent it can not be taught. But a good person who has talent for teaching will be much better prepared to do the job if he is armed with knowledge about research into learning strategies, child development, learning disabilities and a wide variety of other subjects. There are few professions with more educated and dedicated members than teaching. I suggest that Cliff Lazar make an appointment with his children's teachers and principals to discuss his concerns and the reasons for their approach instead of calling them names in a magazine editorial.

**John H. Clegg**  
Littleton, CO

## **Objectivity**

Congratulations for the quality of *HP PROFESSIONAL* magazine!

I like very much the presentation, technical information, timely news and the most important point, objectivity.

Please include regular columns about product reviews and usage tendencies in order to help the users meet their growing need for information.

**Juan Medina**  
**Computaciones Lansdata, C.A.**  
**Caracas, Venezuela** ■



## New Version Of HP BASIC Provides Ties To HP-UX Systems

*Offers Large Performance Gains*

**H**P's new HP BASIC (Version 5.0) provides ties to the HP-UX operating system on HP 9000 Series 200 and 300 engineering workstations. This is the first step in integrating HP's powerful instrument-control and program-development environment with the features of an industry-standard operating system.

In addition to many language and operating system enhancements, HP BASIC 5.0 will support the 32-bit HP 9000 computers. This gives users a large performance gain that can be achieved without making adjustments to current user programs.

HP BASIC is a language and development environment that was designed by engineers as a tool for engineers, as opposed to a language designed by computer scientists for programmers. Its design center was instrument control and its purpose was to give non-

programmers an easy means of developing test systems.

HP consistently has researched the needs of HP BASIC customers. As a result of this research, the company has made numerous enhancements to HP BASIC throughout its life. Some of

the customer needs recently identified through this research are:

- Support of industry-standard operating systems — such as UNIX and DOS — is becoming required in today's computing world. HP BASIC needs to link into these standard operating systems and provide file sharing.
- Industry-standard networking: Users need to link test stations together, as well as communicate test results

to other departments.

■ Support of industry-standard databases: Users need to use databases such as Oracle, Informix and Allbase.

■ Preserve customer investment in HP BASIC: While improvements are vital, HP BASIC customers want a system that is compatible with their current system. Past HP BASIC software efforts must be preserved.

HP found that the most effective way to add these capabilities to HP BASIC is to implement it in the HP-UX environment. The first step to moving into the HP-UX environment is to transfer existing programs and data files to the hierarchical file system (HFS) format. HFS is now a part of HP BASIC 5.0.

Advantages of HFS include the large organization of files in hierarchical-structured directories and the ability to share disks and files between HP BASIC and HP-UX.

An immediate advantage of this transfer to HFS is that data is available to be sent over industry-standard networking, or to be entered in an industry-standard database in the HP-UX environment.



*HP now offers HP BASIC, a new control language that provides ties to HP-UX on HP 9000 workstations.*

## Graphics Gallery Enhanced

Offers Users Greater Text Manipulation

HP Graphics Gallery, a business-graphics product family for personal computers, now includes new chart types and options, text alignment and rotation, and support for the IBM Personal System/2 (PS/2).

Other enhancements recently announced include support of PageMaker and Ventura Publisher page-layout programs and direct integration of worksheet graphs into the drawing program of HP Graphics Gallery.

The HP Graphics Gallery family includes HP Charting Gallery for creating easy-to-use charts and HP Drawing Gallery for creating and editing text and illustrations. Each is available separately or as part of the Gallery Collection, which also includes the HP Business Management Portfolio picture library. Other portfolios consisting of symbols and illustrations for specialized applications are available.

The programs can be used with the HP Vectra and Touchscreen PCs; IBM PC, XT, AT and compatibles; and the IBM Personal System/2.

With the new features, users can align text to the left, right or center, and can rotate text and images to any angle, from zero to 359 degrees, either with the mouse or by typing in the degree of rotation desired.

HP Drawing Gallery now automatically can size and place bullets on specified

lines of text. This replaces the manual process of selecting a bullet size and shape, aligning it and then copying it repeatedly to each desired line.

New chart types available with HP Charting Gallery include area charts, combination bar-and-line charts, linear-regression charts for correlating statistics, double Y-scale charts for comparing trends and X-Y charts for showing relationships between sets of data.

Other enhancements make it easier to use HP Graphics Gallery with related software programs.

For example, graphs from Lotus 1-2-3 and Symphony worksheet files now can be integrated directly into HP Drawing Gallery, where all editing features are available. Previously, users

first needed to capture a worksheet graph in HP Charting Gallery before editing it.

For desktop publishing, pictures and charts from HP Graphics Gallery can be integrated into PageMaker, Ventura Publisher or other

page-layout packages that accept TIFF or PC Paintbrush format.

HP Graphics Gallery supports a wider range of output devices, such as General Parametrics Video-Show for computer-graphics printer.

## IEM, ISA Form Alliance

Combining Software, Hardware Talents



IEM, Inc. (Ft. Collins, CO) and ISA Co., Ltd. (Tokyo, Japan) are joining forces to offer the largest and most complete selection of third-party products available to HP computer users. The products offered by these two companies include language compilers, applications software, disk drives and memory interface board products. IEM will be contributing to the venture with its expertise in software, firmware and service, and

ISA will offer its talents in hardware design and manufacturing.

IEM is the developer and manufacturer of the only FORTRAN 77 Language Compiler for HP Series 200/300 computers. IEM's BASIC Language Compiler for BASIC 5.0 is now licensed and sold directly by Hewlett-Packard. IEM has been marketing ISA hardware in the U.S. for the past year, and now will be marketing ISA products worldwide.

In addition to joining its talents with ISA to develop new products, IEM will be establishing a Technical Service Lab to handle product service, testing and repairs. The lab also will be responsible for developing technical service manuals for all new software products.

ISA was established in 1979 and currently focuses on HP-compatible products. In 1986 it was chosen by VEC (Venture Enterprise Center) to develop a large-scale Winchester Disk Testing System for use in production lines.

## HP VISIMAGE Available From Vital Soft

Improves Access To Stored Data

**H**ewlett-Packard has signed an agreement with Cogelog which places VISIMAGE, an end user productivity tool, on HP Corporate's available software list. The product will allow end users to have better access to data stored on HP 3000s. They can select and display information on the 3000 or transfer the selected data to the PC.

Cogelog has a long history of working with HP; ASK and its successor ASKPLUS are used in almost 100 HP sites.

The product is available from Vital Soft (Mountain View, CA), Cogelog's newly created sales and support affiliate.

## New 75 MHz Interface Expands Test Capabilities Of HP 3065 Board-Test Systems

*HP 44607A Improves Overall System Reliability For Specialized Functional Testing*

HP 3065 board-test system users now easily can extend the range of difficult, high-speed measurements that are possible with standard-fixture connections.

The new HP 44607A functional test access card allows users in such industries as telecommunications and aerospace to use a virtually unlimited set of instrumentation through a bed-of-nails fixture to solve complex mixed-signal and analog-testing needs.

This opens up new measurement capabilities by providing easy access to frequency counters, spectrum analyzers and other specialized-test instruments. For maximum flexibility, the new card can be combined with the HP 3235 switch/test unit to connect thousands of different instruments through the HP 3065 board-test system and the HP SimPlate fixture.

Software for testing can be fully integrated into the HP 3065 BT BASIC programming language for synchronized analog, digital and mixed-signal testing. This software already provides digital in-circuit testing up to

10 MHz, analog functional testing and true mixed-signal testing, using a total of 22 hybrid or functional-test access cards.

The new functional test access card provides up to 34 low-capacitance channels with a typical bandwidth of 75 MHz and cross talk of less than -50 dB. This card meets a wide variety of test configurations by accepting up to 34 50-ohm coaxial or twisted-pair connections, 17 shielded-wire pair connections or any combination of these choices.

The new card increases overall system reliability for specialized functional testing, compared to traditional manual-connection techniques. Fewer connections mean fewer operator actions and thus fewer opportunities for error. In addition, eliminating extra cables assists specialized applications, such as automated-fixture handling.

The HP 44607A functional test access card is \$2,950. This includes six coaxial fixture wires for connecting the board under test to the functional test access card, and six coaxial cables for connecting the card to external switches and instruments. In addition, HP offers two cable kits that allow users to customize the cards in their systems.

## Relational DBMS For 9000, 3000 Computers

*The Only Third-Party System*

Oracle Corporation (Belmont, CA), developer and marketer of the SQL-based ORACLE relational DBMS, fourth-generation language tools and decision-support software, has signed an agreement with Hewlett-Packard to provide its software for the HP 3000 Series 900 business computers. The agreement makes ORACLE, to date, the only third-party relational DBMS announced for both the new HP 3000 Series 900 business systems and the HP 9000 scientific systems, both based on HP's Precision Architecture technology.

Under the agreement, Oracle will sell and support the software and HP will participate in joint marketing activities. The HP 3000 arrangement follows a year-old similar arrangement between the two companies for offering the Oracle software on the HP 9000 computers.

While ORACLE runs

with HP-UX, it will run with HP's MPE-XL native operating system on the HP 3000 Series 900 computers.

Peter R. Tierney, Oracle's vice president of marketing, stated, "Major users of HP computers can benefit from their abilities in both scientific computing and commercial data processing while using the same DBMS. Our distributed DBMS architecture, SQL\*Star, will allow HP users to tie their Precision Architecture computers together with one another and with IBM mainframes and PCs to obtain the complete corporate-wide solutions."

The first release of the software will be available in mid-1988 and will include the ORACLE DBMS, Oracle's 4GL tools and the programmatic interfaces. A second release by the end of 1988 will include networking abilities, enhanced report-writing and a full menuing facility.

## PowerHouse Links To CASE Technology

*Users To Employ Excelerator*

Cognos Incorporated signalled its strategic intention to enter the computer-aided software engineering field recently by signing an agreement with Index Technology Corporation (Cam-

bridge, MA). Under the agreement, Cognos will link its PowerHouse advanced application development language to Excelerator, the CASE product from Index Technology.

Cognos is developing a software bridge that will

enable its users to employ Excelerator as a front end to automate the design of PowerHouse applications. The bridge will allow users to upload Excelerator files from IBM PC XT, ATs or compatibles to PowerHouse. The product will be available early in 1988, according to Ron Nordin, Cognos vice-president, product marketing.

An emerging field in the software industry, CASE

technology increases the productivity and creativity of software designers and engineers, allowing them to develop system prototypes on screen instead of on paper. Using tools such as design graphics, structured flow charts, process charts, data modeling and entity relationship diagrams, CASE automates many time-consuming, manual, analysis and design tasks.

## Instrument-Control Language Offered On Three New Products

*Designed For Engineers*

There are three new HP products — a language-processor card and two new versions of the IBM-compatible Vectra PC system — that offer HP BASIC instruments-control language.

The language-processor card, HP 82300A, can be plugged into existing Vectra PCs, or the language can be purchased bundled into a monochrome or color system version of HP Vectra PC called HP PC-308 BASIC controllers.

HP BASIC has been used on the HP 9000 Series 200 and 300 engineering workstations for more than 10 years. Many enhancements made to the language provide advanced I/O capabilities and high performance. It is one of the most powerful and easy-to-use programming environments for instrument control, HP said.

The heart of the PC-308 HP BASIC controller is the MC68000-based plug-in card

called the HP 82300A language processor and MS-DOS emulation software that allow the Vectra to have the same functionality as an HP 9000 Series 200/300 workstation.

HP BASIC runs on the Vectra PC like any other DOS program. Switching back and forth between HP BASIC and popular DOS applications such as LOTUS 1-2-3 or Microsoft Word takes only a few seconds.

"These products were developed as a result of customer research that indicated engineers want IBM compatibility and advanced instrument-control capability in the same computer," said Paul M. Ferguson, product manager for the language processor.

HP BASIC is intended for technical users who are not primarily computer programmers, but who write, adjust or adapt programs used to solve instrumentation problems.



Infocentre Corp. recently took delivery of HP's new 930 RISC-based computer. The company was one of the first to participate in the Commercial Fast Start Program.

## HP 3000 Series 930 Shipped to Infocentre

*Early Commercial Fast Start Participant*

In early September, Infocentre Corp. (Montreal, Canada) took delivery of its HP 930, the first of Hewlett-Packard's new generation of RISC-based computers, known at HP as Precision Architecture.

Infocentre was one of the first companies to participate in HP's Commercial Fast Start Program, created by HP to ensure that key third-party software vendors quickly and easily would be able to migrate their software, and therefore their customers, to the new Precision Architecture computers.

Infocentre is in the pro-

cess of redeveloping its fourth-generation software, known as SPEEDWARE Environment, to take advantage of HP's Precision Architecture.

This 930 shipment was the first to leave for Canada and it has caused quite a stir at the Infocentre Research and Development labs. "Although we have spent considerable time at HP's Migration Center working with the Speedware environment and the HP 930, receiving our own 930 represents an important moment for us," says Ian Farquharson, chairman of Infocentre. "It signifies our commitment to a future dedicated to superior software solutions for the HP community."

## INDUSTRY WATCH

**Lonni Wright**

HP recently became one of the first computer companies to provide a CD-ROM-based support-information service, HP LaserROM. For HP 3000 users, this will replace that dusty stack of manuals with regular mailings of cumulative information on compact discs.

Subscribers to the new service, primarily MIS professionals and managers in system support and software development, will receive updated CD-ROM (compact-disc read-only memory) discs that include reference manual information, application notes, solutions to problems and information about HP products and services.

HP plans to add as many as 10 new information services to the HP LaserROM family during the next year. The new service currently is available only to users of HP 3000 business computers (including the new RISC-based Precision Architecture computers).

BY PROVIDING CD TECHNOLOGY, HP offers support service that is updated regularly, easily stored and quickly accessed. Each disc, similar to those used for reproduction of recorded music (see sidebar), can hold about 600 MB, equal to 200,000 pages of text and graphics or 1,500 floppy discs.

Special retrieval software using full-inversion indices allows you to locate information in seconds. LaserROM was designed to perform searches in a variety of ways. It accepts Boolean Search strings, so keywords can be combined logically with AND, OR and NOT operators. HP LaserROM can search for exact words or strings or specific fields, or it can use wildcard characters. In addition, it can search for keywords that are in proximity of one another.

The disc is read by a compact-disc drive that is an internal peripheral to the Vectra PC or IBM PC/AT. This drive occupies the space of one floppy-drive slot, leaving the other available for general PC use.

Because LaserROM makes use of a PC, access to HP support information is

not dependent on the availability of the main system.

The annual cost per subscription for HP LaserROM is \$2,700, which includes a run-time version of MS-Windows. The service also can be ordered with a starter kit that contains the half-height internal compact-disc drive that you can install in your PC. Deliveries are expected to begin February 1. ■

### [ CD-ROM Technology ]

The importance of CD-ROM technology is the ability to store large amounts of data on compact discs for retrieval later.

A CD is constructed in three parts, beginning with a bottom layer of polycarbonate, a tough clear plastic. On the surface of this first layer are more than a billion oblong microscopic depressions, called pits, arranged in a three-mile spiral track starting at the center of the disc.

Over the polycarbonate is a thin layer of aluminum that follows the contours of the pits. The aluminum reflects light from a laser beam used to read the disc. A third clean-resin layer protects the top of the disc and carries its label.

Data is represented on the disc by the pits and flat spaces between them called lands. A laser beam reads the data by measuring the amount of light scattered or reflected back from the pits and lands.

To guard against missing or faulty data, CD-ROM uses error-correction procedures to make sure accurate data is delivered from the disc. Before the data is recorded on the CD, certain calculations are done and the results are stored on the disc. Later, when the data is being sent from the disc to the computer, the same calculations are performed again.

With its efficient error-trapping mechanism, only one undetected error would escape in 10 quadrillion bits of information. One disc out of 20,000 CDs would contain one error.

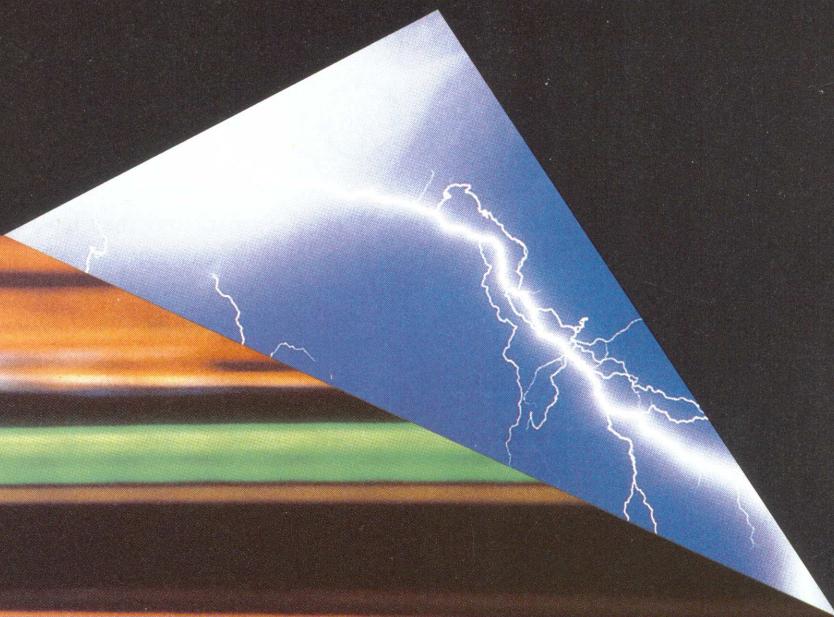
Manufacturing CDs starts with data preparation. All material to be put on the CD must be in electronic, machine-readable form for processing. Once the information is in the proper electronic form, full inversion indexes that include all relevant words on the CD are produced by an automated process. The files containing information and indices go through a pre-mastering phase in which error-detection codes are calculated and added to the information.

Creating an original CD (mastering) begins with a glass disc coated with photoresist. A laser beam is used to cut away parts of the photoresist, laying down the spiral track of pits just as they will be on the finished disc. Through a series of intermediate steps, a metal stamper is produced.

Duplication occurs by injecting polycarbonate into a mold and then using the stamper to impress the pits on the surface to produce transparent discs. Next, the discs are coated with the layer of aluminum that will reflect the laser beam when the CD is read.

After the aluminum coating is in place, the discs are coated with a protective layer of resin. Finally, the discs are inspected for quality and labels are printed.

# Introducing, the 4GL Environment



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ENTER 198 ON READER CARD

## OPINION

### J. Michael Mason

service policy that's been in existence for at least 10 years. Prior to August 1, HP's Out-Of-Coverage option provided Time and Materials customers the option of upgrading the service call response time from three days to four hours for an additional charge. As of August 1, this option no longer is offered. HP has offered no official notification or any explanation to its T&M customers of this policy change.

This is but another prime example of HP's insensitivity to its customers. It has used its maintenance record and policies as a selling tool for many of the 30,000 3000-systems sold. HP now arbitrarily decided to eliminate some of those services to its customer base. It might be assumed that the rationale behind this policy change is that resources can't be adequately planned for four-hour response times for T&M services.

However, that assumption was eliminated by Hewlett-Packard. T&M customers have been told that even if a customer engineer is "sitting on his hands in the office," he won't respond to a T&M customer's needs for three days (or the next day with an additional charge if a CE isn't busy then).

This is called service? Would DEC or IBM treat its customers this way? I think not. These statements also eliminate resource allocation as a rationale. What is HP afraid of?

Could this policy change be an admission that, on the whole, HP makes far less money on those accounts that utilize Time and Materials service ver-

sus its contract maintenance services? Is HP worried that those of us who help customers make the transition to Time and Materials service are getting our message across?

Why wasn't there any advance noti-

Remarketers then have to back-charge their customers for "repairs" that HP makes to the equipment. Where does it stop? If it no longer suits its needs, will HP cancel other long-standing policies that its buyers have come to rely on?

**T**his is a question that demands an answer to the entire HP community, not just its T&M base.

fication? HP offices across the country have open Purchase Orders from T&M customers for four-hour response time so they easily could identify most of these customers. Was it to eliminate the lead times necessary for those customers to find an alternative to HP that HP waited for its T&M customers to call for service before telling them that it no longer would respond in four hours, at any price? What is HP afraid of?

This is a question that demands an answer to the entire HP community, not just its T&M base. This type of arbitrary and ill-executed policy change seems to be pervasive in HP's Customer Service Division (CSD).

In a Federal Antitrust suit filed two years ago in California, it's alleged that HP's CSD systematically tried to destroy a third-party service organization through innuendo, falsehoods and policy changes. That case is still pending.

The CSD division also provides certificates of maintainability for equipment that's sold by the user in the computer after-market and maintained by HP. Many offices don't honor the spirit, intent, or letter of the certificate.

Is this, then, the future for the HP user base: reduced services, acute paranoia of minor competition, wholesale disenfranchisement of segments of the HP community and ill-conceived, hastily executed policies, again with no regard as to the negative impact those policy changes will have to its user base?

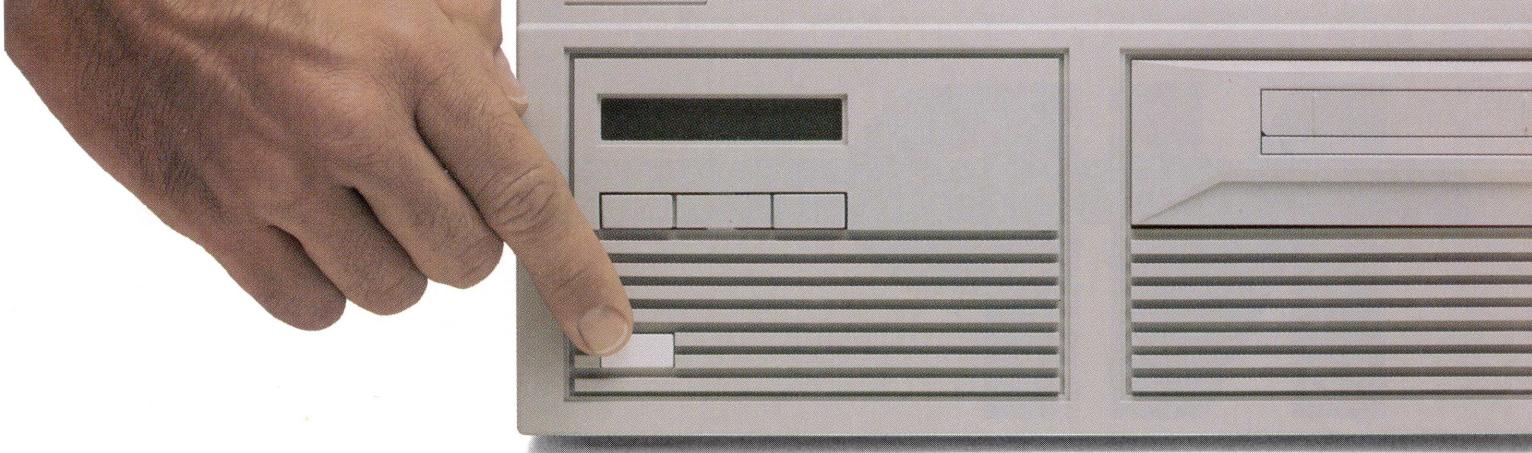
These are questions that every user should demand HP answer. While I have you in a questioning mood, ask yourself:

What if . . . HP decides to change its five-year notice of obsolescence policy?

What if . . . the computer equipment you own has reduced wholesale value because HP decides not to honor certificates of maintainability?

What if . . . it was your decision to buy HP equipment for your company, based upon HP's current policies that then arbitrarily change? Will your management forget that it wanted Digital or IBM?

The next time you see an HP representative, make it a point to ask him, "What is HP afraid of?" —J. Michael Mason is the president of HyPoint Technology, Inc., Cleveland, OH.



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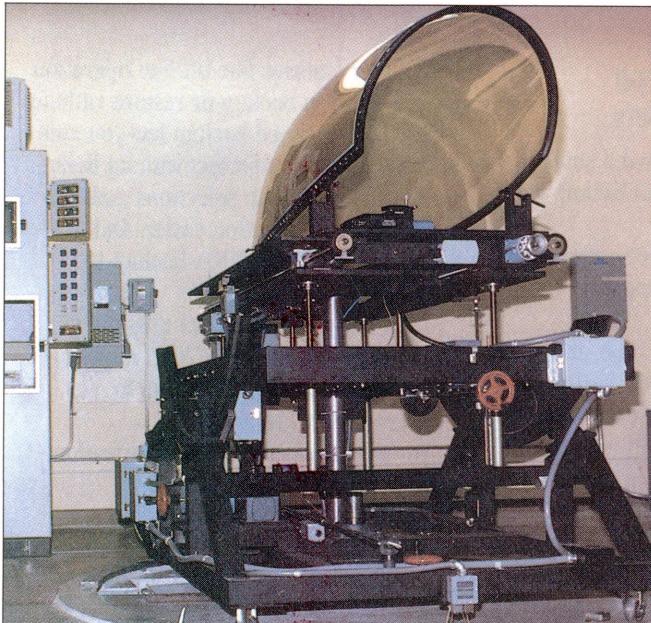
# NP

## Robometric Measures Angular Deviation

A device developed by Robometric Motion and Vision Systems (Canoga Park, CA) measures the angular deviation of a beam of light projected through various points on an aircraft windshield or canopy. The operator secures the windshield to a tooling plate on a fixture, enters the part number and serial number, turns on all the motors, the instruments, the computer and the main power, and presses cycle start to begin the inspection cycle.

Six motors move the fixture to the inspection positions where a sensor measures the deviation from the center of the fixed light beam. An HP 9300 Series computer controls the movements, collects data, analyzes it and prints a report.

Windshield inspection times are cut drastically and data errors are eliminated compared to manual inspection. The system consists of a fixture, electronic controller, light beam transmitter and deviation sensor.



*This device developed by Robometric measures the angular deviation of a beam of light projected through various points on an aircraft windshield.*

Contact Stephen A. Wolcott, Robometric, 7018 Oso Ave., Canoga Park, CA 91306; (818) 887-7116.

**Enter 928 on reader card**

## CJ/EMPLOYEE Now Reflects Tax Law Changes

Collier-Jackson's most recent release of the CJ/EMPLOYEE Fund Administration system provides features for compliance with tax law changes affecting employer-sponsored retirement programs such as the 401(k).

The system calculates average deferral percentages for both higher and lower paid employees to use in discrimination testing formulas. It monitors pre-tax and after-tax contributions to verify compliance with federal requirements.

Calculations for employer matching contributions are defined and accumulated by the system. Interest earned by the plan can be distributed back to participants using various methods of allocation.

The system accommodates multiple

plans per employee and determines eligibility (based on hours of service or length of service) as well as vesting status for each plan. For 401(k) plans, several discrimination reports can be produced upon request and a forecast shows needed adjustments.

Collier-Jackson develops, installs and supports a growing family of online software for the HP 3000 series of minicomputers and DEC VAX series.

Contact Collier-Jackson, Inc., 3707 West Cherry St., Tampa, FL 33607; (813) 872-9990.

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## IEM Introduces Space-Saving Winchesters

IEM has introduced 3½-inch Winchester hard disks and combination drives. These 3½-inch Winchesters offer all the features of the 5¼-inch Winchesters, but take up less space.

Supporting the CS-80 data transfer protocol, these hard disks come in 30-, 48- and 96-MB capacities. The 30-MB and 48-MB hard disks can be purchased with a built-in flexible drive for 3½-inch IDD/2DD (one-sided, double density) disks, or for 3½ IDD/2DD and 2HD (two-sided, high-density) disks. High-density disks can store up to 1.6 MB of information per diskette.

All 3½-inch Winchesters are available for a wide variety of HP computers, including the HP 1000 and HP 9000 Series 200/300.

Contact IEM, Inc., P.O. Box 8915, Fort Collins, CO 80525; (303) 223-6071 or (800) 321-4671.

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## Medical Logic Offers Historymaker 4

The new Historymaker 4 from Medical Logic International is a physician's medical chart processing system that converts clinical data from any disarray in which it's entered into a fully structured problem-oriented record.

By using dozens of pertinent databases, lightbar menus are generated for virtually all input. The costs, delays and potential errors of typing are made minimal.

Historymaker 4 (\$995) contains hundreds of problems, diagnoses (with ICD-9-CM codes), drugs, tests and treatments for instant display and use. Output is organized by patient, problem, data, S.O.A.P. category, hour and minute.

The data may be reviewed from the display or the printed page. Using the same lightbar selection method, any item may be chosen for an effortless search of all records in the physician's practice to show who has what and when it occurred.

The application is written in dBASE and optimized with QUICKSILVER to assure networking at will. It runs on the HP Vectra and compatibles.

Contact Medical Logic International, 5 Pathfinder Dr., Sumter, SC 29150-3135; (803) 469-9180.

**Enter 903 on reader card**

## Infotek Announces

### 32-Channel A/D Converter

Infotek Systems introduces the AD300, the first board-level analog-to-digital (A/D) converter with a 32-channel capacity and four-channel simultaneous sampling capability for HP 9000 Series 200/300 workstations.

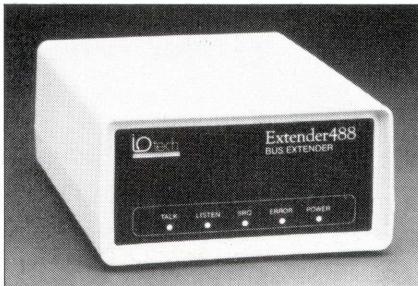
The AD300 (\$1,900) was developed to provide the true simultaneity necessary for applications such as sound and vibration analysis. It performs multiple-channel data acquisition, allowing 32 single-ended analog inputs or 16 differential analog inputs.

The AD300 speeds data-acquisition activities. It operates at a throughput of 200kHz and provides 12-bit resolution. Infotek designed the AD300 around a microprocessor that controls all on-board operations and reduces program control by the host HP computer. The host's processing load is further reduced by a 64K FIFO buffer on the AD300.

The AD300 is programmable using HP's GPIO protocol allowing users to set up card functions with only a few lines of code. Because the AD300 employs the GPIO protocol, the AD300 supports BASIC, PASCAL and HP-UX operating environments.

Contact Infotek Systems, 1045 S. East St., Anaheim, CA 92805-8508; (714) 956-9300.

**Enter 904 on reader card**



*IOtech's Extender488/F bus extender helps engineers link two IEEE test systems in different locations.*

## IOtech Introduces Fiber Optic Bus Extender

Engineers now can link two IEEE test systems in different locations through a fiber optic data link with IOtech's Extender488/F bus extender.

Also, the Extender488/F (\$995) acts as a bus extender and doubles the number of allowed devices to 14 each for the remote and local bus network. It extends the bus up to 4,000 feet using a high-speed 115K baud

transmission scheme. The fiber optic link provides high electrical isolation, as well as improved immunity from data transmission errors.

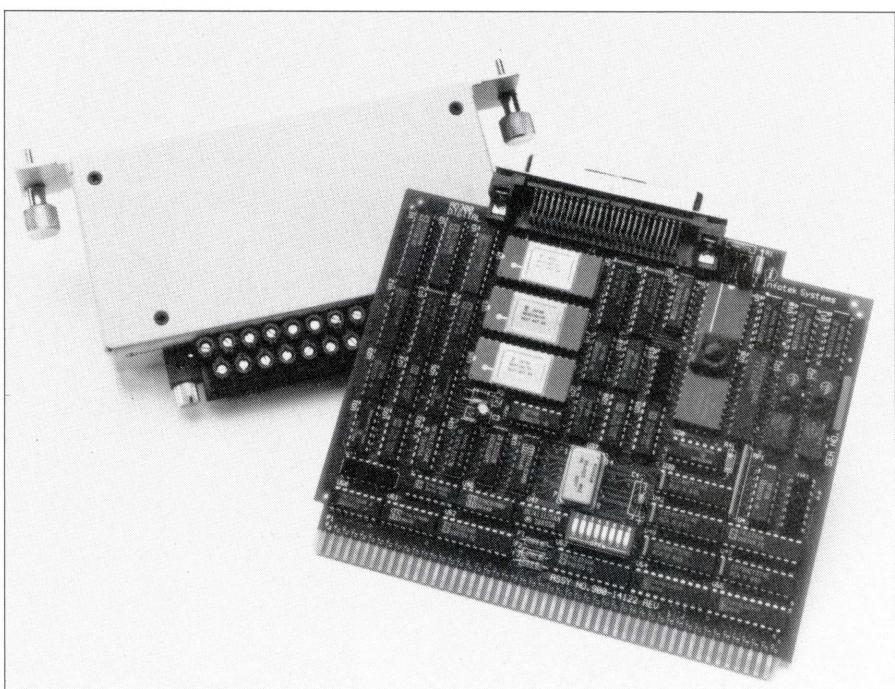
The extenders operate transparently to the IEEE controller, with the exception of parallel poll (speed requirements of parallel poll preclude this feature from operating transparently). When performing parallel poll, the controller performs two polls, and discards the data received from the first poll. Contact Tom DeSantis, IOtech Inc., 23400 Aurora Rd., Cleveland, OH 44146; (216) 439-4091.

**Enter 901 on reader card**

## Kelly XL/3000 RAMDISC Gives Users More Control

Kelly Computer Systems recently introduced the XL/3000 RAMDISC for the HP 3000. Designed around Kelly's plug-compatible 3000 memory boards, XL/3000 allows the user to actually partition all of physical memory into two classes. The user first allocates memory for MPE and the remain-

*Continued on page 88.*



*Infotek's AD300 analog-to-digital converter provides 32 channels and four-channel simultaneous sampling capability.*



# Adager is quick and clean.

**How do you measure "quick"?** By means of a benchmark which YOU can run on your own computer, at your convenience.

The BARUG Database Shootout provided a well-known benchmark, which includes a Turbo-IMAGE database and a list of transformations. Upon request, we will send you a tape with the database, the requirements, and an Adager-generated stream. If you prefer to specify the transformations using another sequence, you can generate your own stream file, automatically, by running Adager with "parm=8" in session mode. Naturally, if you cannot stand the thought of batch processing, you can just run Adager OnLine. You will enjoy duplicating the benchmark on any machine of your choice. Here are our results, for your reference.

#### Adager runs the BARUG benchmark in:

2 hours 29 minutes on an HP3000 Series 42 with disc caching,

1 hour 14 minutes on a Series 70 with disc caching,

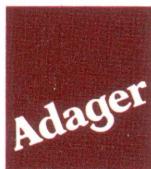
46 minutes on an HP3000 Series 930,

29 minutes on a Series 950.

**How do you feel "clean"?** For starters, please consider this: You receive a small Adager tape that you install in a couple of minutes on ANY HP3000 computer running IMAGE/3000 or Turbo-IMAGE under MPE or MPE-XL.

A program that runs on a Series II (vintage 1976), on a Series 950 (vintage 1987/1988), and on any HP3000 in between, definitely qualifies as "clean". But besides just running, Adager runs well. Adager is good, clean fun!

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*Technology For Design And Development*

# *Expert Systems In Engineering*

[ By Dr. Michael M. Dediu ]

# A

n engineer's job often consists of the design and development of

products or services. These tasks include the application of knowledge gathered from academic learning and from experience.

Unfortunately, the academic knowledge often is lacking in "real-world" expertise, and the experience is difficult to acquire. Acquiring experience takes time, which could be used more efficiently in the creative problem-solving process.

For example, in electrical engineering design, considerations such as minimizing the size of circuits while maintaining a reasonable temperature is not a skill acquired easily. The teaching of such techniques is not a priority in universities and must be learned by reference to an in-house expert, reading a book (if available) or by trial and error. These methods have drawbacks: The expert is non-existent or very busy, the book may not be available or may be too superficial and the trial and error method is costly in time, money and patience.

Fortunately, advances in computer science and software engineering and an increase in the high-speed computer population have made possible the development of expert systems of noteworthy value for the engineer in many fields, including design and fault diagnosis. More important, there exist expert system development

packages that allow the engineer or scientist to program and create a site-specific expert system serving any number of engineers.

## What Are Expert Systems?

**E**XPERT SYSTEMS ARE computer programs that emulate the behavior of an expert in a specified domain of knowledge. They have been developed for many functions. These functions are too many to mention, but here are some examples:

- diagnosis
- data analysis and interpretation
- design
- planning
- learning from experience
- concept formation
- signal interpretation
- monitoring computer-aided instruction
- tutoring
- knowledge acquisition
- image understanding
- engineering
- defense

An example of an expert system in engineering is Cost & Manufacturability Expert, produced by Cognition Corp. One module of the system, the Tutor Module, helps in building cost models. The second module, User Module, will analyze the feasibility of manufacturing. This expert system is a useful tool for mechanical engineers in the design phase, where about three quarters of a product's cost is spent.

The price of the system is about \$175,000. It runs on Cognition's Mechanical Advantage workstation, which is constructed based on a DEC VAXstation II/GPX, using ULTRIX as the operating system.

A famous expert system used in engineering is XCon, which helps configure DEC's VAX computers, networks and clusters. This AI tool is 10 years old and was created by Digital Equipment Corporation in cooperation with Carnegie-Mellon University. XCon's knowledge base is a collection of facts and procedures for assembling VAX systems. It now contains approximately 6,000 rules, and has been growing by about 1,000 rules per year. VAX 11/780 XCon has helped configure every new VAX system. Up to three years of history on VAX equipment is contained in XCon. It is estimated that it saves Digital more than \$35 million a year, even if the annual maintenance costs are more than \$2 million. Its initial investment was estimated at less than \$70,000.

This well-developed expert system does the work of more than 600 people, and is essential in helping Digital build

customized VAX systems.

XCon shows that the best way to create expert systems is by cooperation between industry and academia. Many universities such as Massachusetts Institute of Technology, University of California at Berkeley, Stanford University, Carnegie-Mellon University and Cornell University have the capabilities to develop expert systems if several million dollars of research money are offered.

One field that appears to be ready for expert systems is network management. The networks become more sophisticated, and the only efficient way to manage call routing, support services and private networks is an expert system. It can check many elements almost simultaneously and react very quickly to changing conditions.

Several companies already have their own expert system tools. For instance, BBN Communications Corp. uses DESIGNet for capacity planning, design and performance management of its proprietary wide-area networks. TRW Inc. also has some personal computer-based expert systems for its service consulting and operations groups.

Expert systems will help considerably in the network management areas of design, diagnosis, troubleshooting, and capacity planning.

A remarkable characteristic of more advanced expert systems is their ability to learn from their experience and add new facts to their knowledge space, and even new rules to their inference engine.

The folks at AT&T Bell Laboratories have their Network Management Expert System, or NEMESYS, that's used for the enhancement of the efficiency of long-distance network management operations. They also are working on a network management product that incorporates expert systems. For example, Starkeeper Network Troubleshooter is a real-time interactive expert system that helps data administrators to diagnose the Datakit Virtual Circuit Switch networks. This system also has learning capabilities.

Expert system-based network management products will become commercially available in the next two to three years.

**I**t's important to note that all these advances in software couldn't come to practical fruition without the advances in hardware performance. All AI applications are notoriously calculation- and space-intensive. The growing density of workstations, minicomputers, AI-dedicated machines (Symbolics, Thinking Machines), personal supercomputers and increasingly powerful personal computers have put the power of such advanced software at the fingertips of engineers and researchers.

The advent of new microprocessors and architectures also have helped. Notably, Hewlett-Packard departed from the traditional 16-bit complex-instruction-set computing (CISC) and created 32-bit reduced-instruction-set computing (RISC) minicomputers. RISC architectures are recognized as an im-

portant development in the acceleration of computer processing power.

The commercial Series 3000 Model 930 Spectrum computer, with HP's own MPE/XL operating system, and especially the UNIX-based (System V) Spectrum computer, the Series 9000 Model 840, are good tools for expert system users. HP's Precision Architecture is a powerful new computer architecture, with software and communications capability from micros to mainframes, that could increase significantly the use of HP minicomputers for information retrieval applications.

The mainframe can act as a store for huge databases. The research engineer is very much interested in acquiring as much information as possible about the project he's working on. Powerful, flexible, natural language interface, expert information retrieval systems based on networks of databases will make gathering information easy and instantaneous.

Along the same lines, there exist expert system applications in combination with relational databases. An expert system easily could help a specialist to design and interactively test SQL queries to improve their performance and functionality. A good expert system could monitor, modify and restructure a database based on its performance in a given application.

Harris Corp. has developed a personal computer-based expert system that troubleshoots the IBM Systems Network Architecture network. This Network Problem Determination Expert System (NPDES) simplifies the network management by finding problems in software and mistakes made by end users. It also gives the status information about users' terminals, control units, paths and applications. The system has 200 rules and helps in over 80 percent of the queries it receives. IBM has its own Expert System Environment package.

Expert systems expand the use of computers to many applications for which they weren't being used at all or were being used very little. Many successful expert system applications are beginning to appear in medicine, business, finance and engineering. There are several commercially available tools for building expert systems in the form of shells and programming environments.

**A** COMMON application of expert systems in engineering is diagnosing faults in a system and suggesting recommenda-

tions for repair. Such intelligent software has a structure that's easily understood and can be considered a "common-sense" approach.

For example, NASA Johnson Space Center scientists implemented an expert system for automated fault isolation and correction of a CO<sub>2</sub> removal subsystem destined for the space station. This expert system simulates the behavior of the CS-1 device, an electrochemical CO<sub>2</sub> subsystem for removing CO<sub>2</sub> from cabin air. It allows the user to interactively identify a fault and then diagnose it.

One set of rules is used to isolate the fault to a particular subsystem; another set then is applied to identify the faulty component within the subsystem. The knowledge representation is done by using the frame data structure. The frame representation reduced the number of rules in the system by eliminating the necessity for rules to express the relationship between objects.

The components are graphically represented, displaying a unique bit-map picture, which allows the user to choose each icon to select faults or component states. The method for solving a situation is backward-chaining; that is, several hypotheses are tested in sequence.

A particularity of this expert system is the subdivision of a problem into two levels: First it finds which subsystem the fault occurred in and then looks for the faulty component within that subsystem. This decomposition of the problem is done by having one set of rules identifying which subsystem was faulty, based on the heuristics that examined the voltages on the multiple cells removing the CO<sub>2</sub>.

The second set of rules, working within the context of a certain subsystem, finds which component was faulty by analyzing gauge measurements along the flow of gases in the subsystem. The two sets of rules are called separately, the first by a top-level command to start the diagnosis, and the second by the first set's successful conclusion.

This expert system also has the capacity of running tests on the system, if some of the diagnostic conditions require this. For instance, to see if an object is obstructing a valve, the technique is to test the pressure, close and open the valve, and then check the pressure again for changes. Here we have

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nonmonotonic reasoning; that is, a reasoning that allows facts to change rather than only add them, and the rules are of the type (IF(A1)AND(A2)AND(A3)THEN(B1)). From this example, we see that the expert system building tools should have a wide variety of paradigms.

Another example of a diagnostic expert system is used by Ford Aerospace & Communications Corp. The data are not discrete faults, but occur in telemetry streams to be monitored. This expert system deals with satellite problems during a single pass of the satellite over a ground-tracking station. The user has a graphic interface with the system.

When the satellite passes over the ground station, the diagnostic system detects fault symptoms, diagnoses the faults, generates recommendations for action, presents these recommendations and allows the user to implement a recommendation. The system will monitor the fault symptoms until they disappear, independent of the user's actions.

The expert system simulates two groups of specialists who each observe different subsystems of the satellite. The first group monitors parameters associated with the subsystem being observed. If fault symptoms appear, this first group in-

forms the second, which diagnoses and observes the subsystem until fault symptoms no longer appear. Solutions and priorities can be discussed between the two groups.

The knowledge representation is done with frames, which define each of the components, subsystems and classes of components and subsystems in the satellite. The inference engine contains sets of rules for detecting fault symptoms, diagnosing faults and establishing priorities. Each component and each subsystem in the satellite is represented by a unit, or frame data structure, and is connected to other components by slots, or attributes, in the frames. The satellite controller can react to the recommendations received from the expert system, by using the YES or NO text images or by requesting an explanation with the WHY image.

The processing strategy for the diagnostic system begins with data-directed reasoning. The expert monitor units use forward-chaining reasoning on rules to determine if a fault symptom has occurred. If this is the case, the expert monitor unit will spawn a guardian unit to diagnose the problem. These units use a backward-chaining paradigm.

A guardian unit will remain as long as the symptom that

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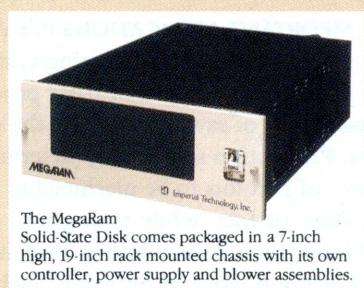
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triggered it still exists; when the symptom is corrected, the guardian unit deletes itself. Both monitors and guardians are represented as units in the system, not as a single set of rules. The guardian expert unit is independent of the user's actions, allowing the guardian to generate recommendations asynchronous to the user's actions directed at correcting other faults.

Another expert workstation application was developed by Electric Power Research Institute and IntelliCorp for determining the correct shuffle pattern for fuel assemblies in a nuclear power plant. The problem was to reduce the cost and time necessary to determine nuclear reactor fuel assembly configurations. Each nuclear reactor is fueled with about 150 to 200 assemblies, each containing nuclear fuel.

After nine to 12 months of operation (one cycle), all of the assemblies have been depleted (burned up) to some degree. Approximately one third of them usually are discarded and replaced by new assemblies. The entire set then must be rearranged to create a homogeneous, stable power distribution that achieves maximum burn-up without spikes of power, which require the entire plant to be run at a reduced power output level. This expert also has a frame representation and two sets of rules for suggesting procedural problem-solving steps and specific assembly moves.

## Flexible Manufacturing Systems

**I**MPORTANT APPLICATIONS of rule-based expert systems are in flexible manufacturing systems (FMS). An FMS can process many types of parts produced in lots, from the release times of raw materials to the due dates of completed parts. Production scheduling (determining a schedule or sequence of part lots to be machined in the FMS) must meet the due dates of lots, while taking into account several related problems, such as minimizing machine idle times, queues at machines and work in progress. Such a scheduler was written in OPS5, a rule-based, domain-independent production system language. An OPS5 program contains a global database, called working memory, and a set of rules operating on it.

The Diagnostician is an expert system whose purpose is to identify the initiating disturbance, and any misoperating devices responsible for an accidental change in the configuration of a network. The Diagnostician views a power system as a collection of buses (nodes), lines (devices connecting pairs of buses), breakers and relays. The buses and lines can be in two conditions: faulted or un-faulted. The breakers and relays also can be in two conditions—properly operating or misoperating. The Diagnostician attempts to determine the condition of each device, given data on the initial and final configurations of the network. These data may contain errors incurred in collection.

The U.S. Naval research laboratory sponsored an expert system that directs or assists a technician in diagnosing faults

in a piece of electronic equipment. This fault isolation system (FIS) has extensive knowledge acquisition capabilities, and is written in FranzLisp and runs on a VAX 11/780 computer.

The principal novelties in FIS are: the ability to reason qualitatively from a functional model of a complex unit under test without numerical simulation, an efficient knowledge acquisition capability, and a probabilistic reasoning method specialized for device troubleshooting. The basic approach to diagnosis is that of following local causal rules to obtain dynamically all possible causes of various abnormal test results.

Synapse is an expert system for supporting VLSI design. The primary goal of the system is to enable very high level specifications of a problem, consisting of the desired functional and performance specifications, to be mapped into custom VLSI circuits. More generally, the system architecture supports the development of integrated software-hardware systems. A small set of algebraic primitives is used to model several of the levels of abstractization along the dimensions involved in VLSI design. Systems at all levels of abstractization, and all dimensions, are represented as algebraic expressions. The translation process consists of repeatedly transforming expressions that represent system descriptions.

## More Applications

**D**ESCRIBED HERE were a few well-regarded expert systems, but the applications are much more diverse.

Knowledge-based expert systems are used to configure newspaper printing presses, to analyze chemical spectrograms, to help in medical diagnosis, in mineral exploration, in computer system configuration, for electromagnetic non-destructive testing, visual solder-joint inspection, for diagnosing faults in digital data loggers, for diagnosis of large mainframe peripherals, for magnetic resonance systems, printed wire boards, software maintenance, aerospace manufacturing, real-time control applications, electro-center design, boiler design, loop plant maintenance activities, trouble analysis of switching equipment, statistical analysis of experimental data, decision analysis, transportation problems, logic test generation, producing testable combinational circuits from redundant circuits, information retrieval system for the national archives, and many other areas.

With such diversity and power, it's very natural to expect that this field will evolve and grow exponentially. The service of computers in the human endeavor has just begun.

—Dr. Michael M. Dediu is president of Dediu Computer Consultants, Tewksbury, MA.

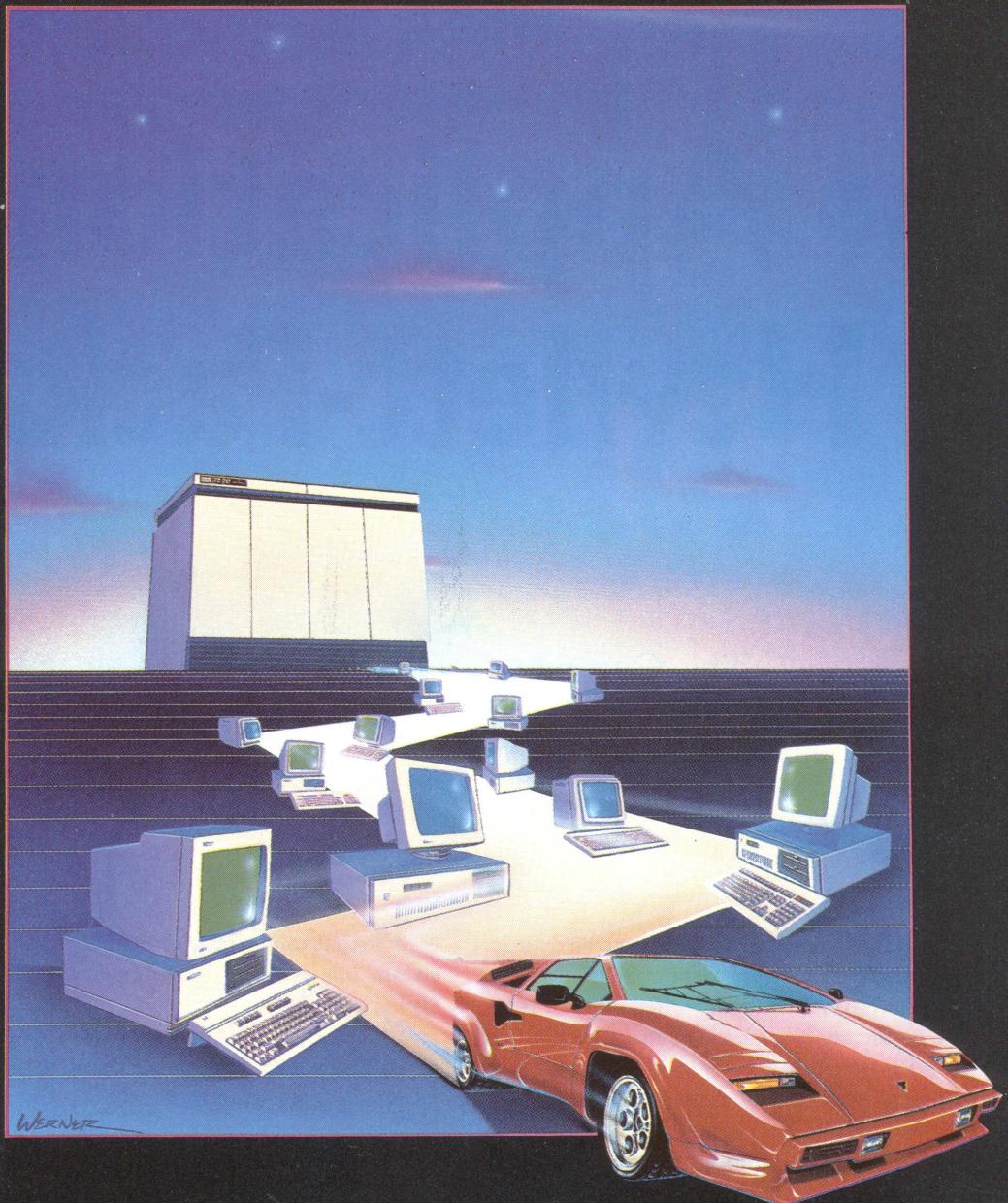
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# AI Applications At Hewlett-Packard

The Company's Directions And  
Offerings In Artificial Intelligence

**A**rtificial Intelligence applications can be defined as programs that make machines do things that require human intelligence when done by people, or the study of how to make computers do what people currently can do better.

The AI community is divided about what projects actually should be considered artificial intelligence and the best areas for productive research. But even though the principal areas of artificial intelligence are still in experimental states, the objectives of this science are clear. The primary goal of artificial intelligence is to make machines smarter. A secondary goal of AI is to make machines more useful to a wide body of users.

In this article, I'll talk about HP's work with artificial intelligence applications, HP's direction, its current AI offerings, both tools and applications, lessons learned, and issues still to be resolved.

Artificial intelligence at Hewlett-Packard is considered a fundamental, enabling technology. Problems that previously have been considered too complex or too vague, or involve too much change, are now being tackled using AI technology. This allows HP to deliver sophisticated new solutions to

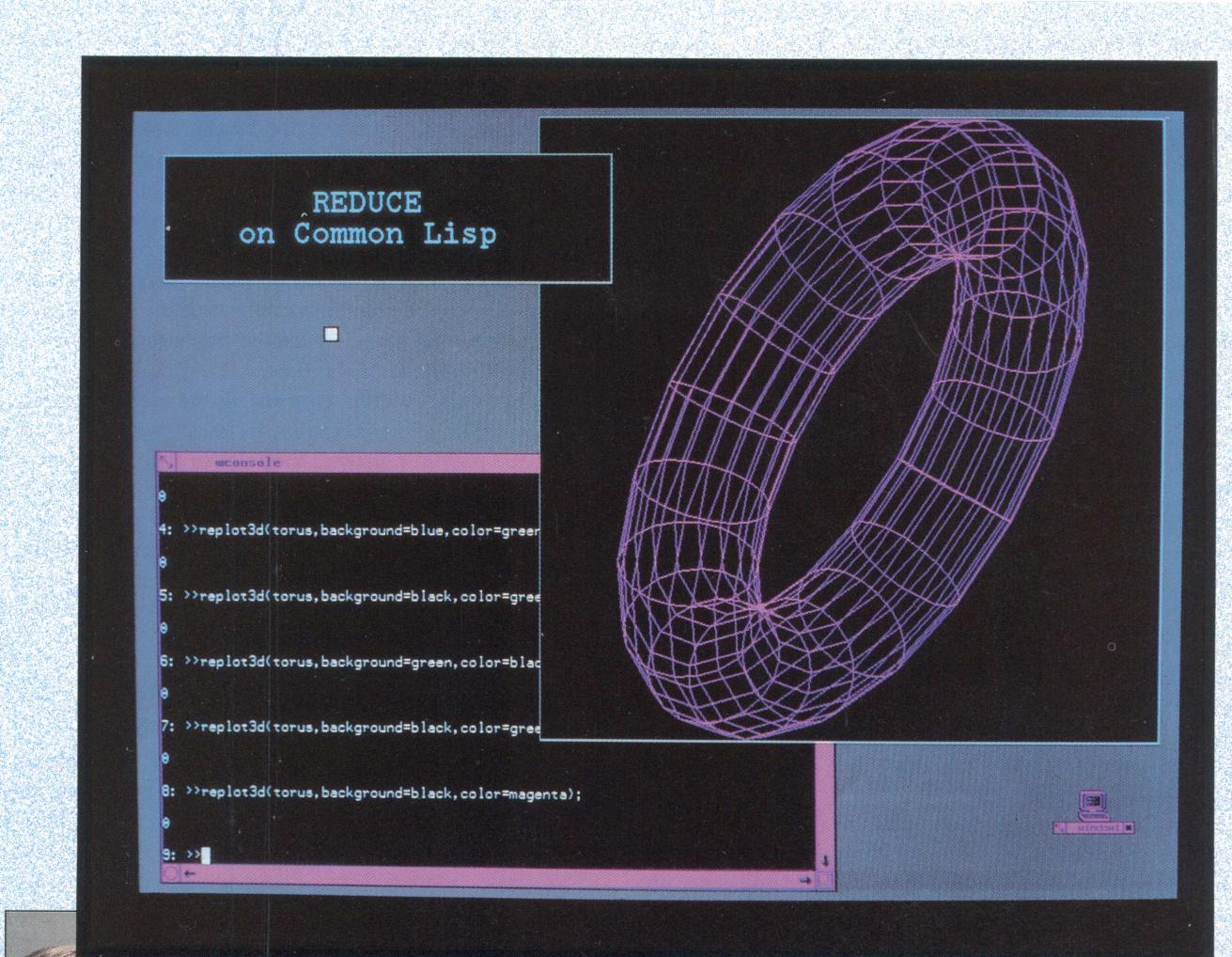
complex customer problems in a timely fashion, as well as stream line internal development and improve production cycles.

All of HP's functional areas provide possible AI research problems. Whether in instrumentation, manufacturing production or computing systems, information management, or software and hardware development, AI promises to help improve quality, consistency and performance of HP's products, and ensure increases in productivity and improvement of the working environment.

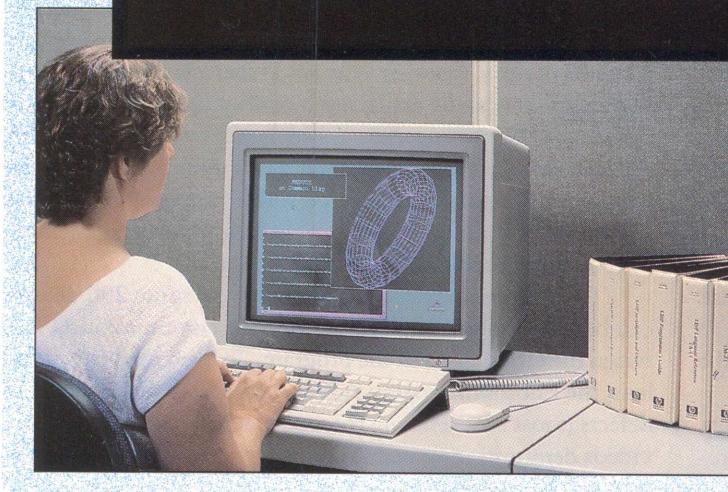
HP plans to continue this emphasis on AI research, acquiring industry-standard tools where such tools exist, and provide unique and powerful solutions to customer needs where they don't. AI will continue to play a role in new product offerings as well as internal applications and development.

[By Don Dyer]

**A**RTIFICIAL INTELLIGENCE technology spans several HP computing families, from the Vectra/MS-DOS systems through the 9000 technical and 3000 business computer families. This crosses several system architecture boundaries, providing AI solutions for most of HP's systems.



*REDUCE is an interactive algebraic programming system that helps scientists solve mathematical problems.*



Many types of AI software and tools are available on HP computing systems, from industry-standard languages, such as Common LISP, PROLOG, C, FORTRAN, PASCAL, etc., and public domain tools to special-purpose or application-specific tools and general purpose third-party tools.

Common LISP is a full-featured LISP dialect that provides the software developer many powerful capabilities needed in solving complex application problems. It is an industry-standard dialect, assuring higher application portability.

HP Common LISP also provides an extensive interface to existing programming languages and software libraries, and object-oriented programming extensions to the standard Common LISP language.

PROLOG allows the programmer to describe the solution of an application problem using symbolic logic in much the same way that humans reason about the correct answer. This allows the programmer to describe the logical content of a solution without being overly concerned with the procedural constructs used to find the solution. HP PROLOG is completely integrated with the Common LISP environment.

REDUCE is a powerful, interactive algebraic programming system that helps mathematicians, physicists, engineers and other scientists solve mathematical problems. It provides facilities to solve algebra, calculus, matrix, factoring or systems of equations problems, using arbitrary-length integers or floating-point real numbers. Solutions may be displayed numerically or graphically.

AI Contrib is a collection of AI programming tools and libraries provided as convenience for software developers. It includes expert system shells, object-oriented and other programming languages, and programming aids. These tools have been obtained from the following sources:

1. Public Domain — code available without license or fee, though a distribution fee may be required.
2. Free Copyrighted — software that may be freely distributed as long as distribution requirements of the author are met.
3. Contributed — code developed by users of the HP AI development system and offered for free distribution.

**T**OOLS WITHOUT APPLICATIONS, however, do not demonstrate the advantages that AI provides in problem-solving, or prove its importance to the development of new products and solutions.

There are many problem areas amenable to AI technology. This selection of application areas does not attempt to represent them all. Rather it describes various projects inside HP where AI technology was used to solve real problems or improve customer products. No one particular AI technology is used, but the technologies are matched to problem and organizational requirements.

Many of these systems were started as concept-proving prototypes. Once these were shown to be successful, additional time was spent to complete functionality, reconsider initial

design decisions, or expand the solution to address more of the problem area. As such, they represent some of the continuing AI research at HP.

**T**HE ELECTROCARDIOGRAM ANALYSIS (ECGA) program provides the analysis capabilities of stand-alone computer systems in a single instrument at an affordable cost. The ECGA advisor generates a preliminary interpretation of the ECG, which can be used to aid the diagnosing physician or where physicians skilled in ECG diagnosis are not immediately available. The interpretation produced has been found to be diagnostically correct better than 90 percent of the time.

The ECGA program contains all the medical criteria for making an ECG interpretation. It "sees" the ECG by means of all the previous analysis modules in the instrument. The criteria program is similar to an electrocardiography textbook. Each major abnormality category is a separate category in the criteria. Within each category are the rules for diagnosing the various gradations of a particular abnormality. Similar to medical texts, there are also rules that specify the relationships between diagnoses in different categories.

## Photolithography Advisor

**T**HE PHOTOLITHOGRAPHY ADVISOR is a program for diagnosing manufacturing defects occurring during integrated circuit fabrication. Given a set of observed defects on a silicon wafer, the Advisor diagnoses process errors causing these defects and recommends corrective action.

The Photolithography Advisor interacts with process line technicians to collect symptoms in the form of observed defects and, if necessary, machine settings. It then diagnoses the process error that can be explained by the symptoms, asking additional questions as needed, and advises corrective action. This action may take the form of asking that a machine setting be adjusted, calling maintenance personnel to perform a certain operation, reworking the wafer, or calling the process engineer in to solve a problem the program cannot.

The terminology used to describe the some 200 defects can be a major impediment to effective communication between the technician and the program. To overcome this problem, the Photolithography Advisor uses laser disk images of defects (most at several microscope magnifications) and short videos demonstrating maintenance procedures to provide examples and explanation.

## Plato

**P**LATO IS AN EXPERT system that interprets low-resolution mass spectra, infrared spectra (IR) and other user-supplied information to produce a list of the functional groups present in an unknown organic compound.

Plato assists the chemist in the task of identifying an unknown compound by generating a list of functional groups consistent with the input data. The program is able to interpret mass spectra, infrared spectra, molecular structure and ultraviolet/visible spectra. Other structural information supplied by the analysis, such as elemental information or knowledge of the sample source, also can be used by the program to guide its search. The program can answer questions about its reasoning process and suggest alternative explanations at the user's request.

Operating alone, Plato quickly and automatically can classify unknowns according to their major functional groups, which may provide valuable information about the systems being analyzed. By serving as an expert assistant, the program also can substantially reduce the cost of a precise identification of the compound under analysis.

## RBEST

**R**BEST ANALYZES PRODUCTION line test failure data of disk drives and produces a failure summary sheet. This system is currently in use at HP on the manufacturing line.

RBEST assists the production engineers in improving the failure diagnostic stage of the final test for the HP 794x disk drive line. Six HP 1000 computers using four 12-hour parametric tests exercise from 12 to 18 disk drives at once. This processing results in very large data printouts. RBEST takes the test result files from the test machines and analyzes them to produce a concise summary page with the failure description, suggested repair strategy and supporting symptoms. The average failure diagnostic time has been reduced from four hours of technician time to one and a half minutes of computer time.

## Parts Selection Advisor

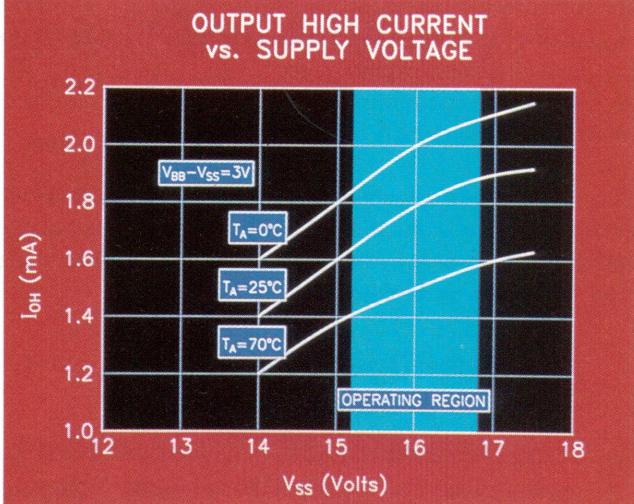
**P**ARTS SELECTION ADVISOR (PSA) condenses the diffuse knowledge of several manufacturing experts into a system that design engineers can use. By leveraging this store of manufacturing knowledge, an engineer can produce a product that will be more economical to manufacture.

PSA reduces design and development time of new products by influencing the design engineer, early in the design cycle, to choose components that meet the required functional characteristics, fit the manufacturing process, are supplied by preferred suppliers, and maximize component commonality. It provides a friendly, interactive front end to a corporate-wide parts database, complete with help screens and explanations of questions and data formats. It retrieves parts from the parts database which meet the designer's functional requirements, limits the search to components from preferred suppliers, and passes the resulting list of parts to the second selection phase.



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The PSA then applies its knowledge to derive five manufacturing measures for each part:

1. Preferred supplier index — based on technical, quality, reliability, delivery and business criteria.
2. Manufacturing process fit — how well the part fits into existing manufacturing operations.
3. Manufacturing setup cost — the cost to add the part into the manufacturing process, including labor costs, lost capacity and material costs.
4. Purchasing costs — the overhead incurred to take on new suppliers, increase inventory, etc.
5. Component commonality — whether there are other parts already available which could be substituted.

Diffuse knowledge spread among diverse experts (and the desire to provide access to this knowledge to a number of users in a form they readily can use) is an obvious application for expert systems technology.

### **Intelligent Peripheral Troubleshooter**

**I**NTELLIGENT PERIPHERAL TROUBLESHOOTER (IPT) is an expert system tool developed to aid in the diagnosis of computer peripheral failures.

The IPT acts much in the same way an experienced technician would if asked to guide a novice through the troubleshooting of a peripheral. IPT asks the user to apply tests and gather observations in its search for a failing component. When IPT has completed a diagnosis to its satisfaction, it prints out the relevant repair hints and a list of components believed to be at fault.

The IPT was designed to allow addition of knowledge about new or modified peripheral devices without major recoding of the system. Components are grouped into logical systems with rules describing typical problems within each system. Using these groups, it may be possible to make IPT diagnose failures by looking at a device on the functional, rather than component, level.

### **Automated Interactive Dump Assistant**

**A**UTOMATED INTERACTIVE DUMP ASSISTANT (AIDA) is an application designed to assist a user in the analysis of memory dumps taken from the HP 3000 family of computers.

AIDA aids the user by automating the tedious aspects of dump analysis. This includes scanning dynamic link, identifying the role of each memory portion, determining what was unusual, and from this determining the general nature or exact cause of the software failure. It automatically can detect simple data structure or subsystem corruption and analyze

some types of class problems. AIDA also provides a superior formatter which makes it easy for dump readers to pursue independent lines of inquiry without changing their environment or their thought flow.

Dump analysis requires detailed knowledge of the operating system and its data structures. By encapsulating this knowledge, AIDA provides a central repository for this information and guarantees that it will not be forgotten or lost as experts move to newer releases of the OS.

**M**ANY THINGS WERE LEARNED in developing these and other AI applications. Some of these lessons are obvious now, but others still are not completely understood.

The most important lesson, however, is well understood, if occasionally ignored. The application must solve a real user problem, one in which the users understand the solution and want the problem solved using a computing system. The R & D lab can deliver an AI solution, but if it's ignored by its intended audience, the application is a frustrating waste of time.

Developing application knowledge is a slow, painful process. It's best if this knowledge comes from within the user's organization so it reflects actual practice instead of theoretical ideas that may not really work.

The delivery machine is seldom the development machine. Budget, location or other constraints may restrict the choice of delivery machine. A successful AI application can happen only when the application is integrated into the existing user environment.

Politics are also important. Never let the zeal for AI solutions obscure organizational realities. Make sure any AI application that crosses organizational boundaries is supported by all sides.

Use the project lifecycle with AI development. Schedule time for requirement gathering, design, coding, testing and maintenance. Recognize the similarities and differences in an AI project to the standard lifecycle and provide the time and resources necessary to flexibly solve all problems.

Don't be afraid to use existing programmers for AI development. Many of the third-party tools and public domain AI tools are designed to be easy to use and understood by programming professionals. Use outside AI expertise sparingly, and preferably only when required. This allows the development of internal sources of AI expertise for future and ongoing AI programming needs, such as application maintenance.

To find possible AI application areas, look for restricted knowledge access, information overloads, inconsistently applied knowledge or those "instant" solutions where the application can "write itself." Is there a critical person, process or organization that causes problems when unavailable? Are there places where the answer is known but requires too much work to find? Look to see if this knowledge is routine, stand-

ardized and fully understood, and verify that a solution is desired by the potential users.

Do not limit application investigations to only one problem. Consider several different problem areas and their solutions. Try to understand the information used in solving the problem and what is required to document the solution. Look at when the problem occurs, and why. Consider the time required to solve the problem. What are the consequences of the solution taking more or less time to find? Look at all costs associated with the problem and its solution. Consider the possible costs if the solution is not optimal or wrong.

Finally, rate the possible AI application on significance to the users, technical feasibility, financial strength and organizational acceptance. This can help focus AI efforts on projects with the greatest chance of technical and political success.

**M**ANY AI APPLICATION DEVELOPMENT ISSUES are still under investigation at HP. These investigations may bring solutions that will improve the acceptance and usefulness of AI applications. Some of these problems under active research include:

- Adding AI applications into existing software without requiring major structural changes to the system.
- Delivery systems that are independent of the development environment allowing applications to easily port to lower performance or different architecture hardware.
- Real-time systems that can respond to external events in a timely fashion.
- Maintenance utilities for use by non-AI programmers to support AI applications. These tools can include sophisticated development environments, symbolic debuggers and automated testing and verification.—Don Dyer is a member of the technical staff at HP's Technical Systems Business Unit, Technical Systems Sector.

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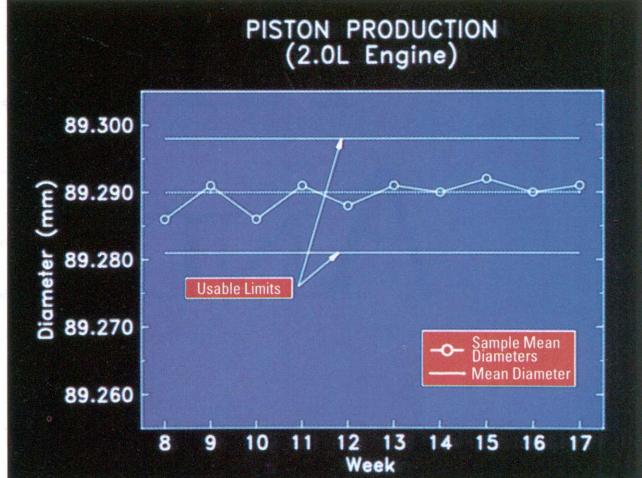
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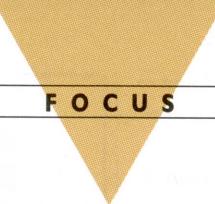
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The Technology Of Knowledge-Based Systems

# AI: MYTH AND REALITY

[ BY ROBERT STANLEY ]

# A

rtificial Intelligence (AI) really is one of many ways in which the future of computing is becoming the present. When some branch of AI research assumes the status of a practical (and practiceable) discipline, it no longer tends to be called AI, but is given a new label of its own, such as object-oriented programming or expert systems.

AI is a label applied to a broad field of largely computer-oriented research, divided into at least 10 major subfields. Although there are no agreed-upon standard definitions of precisely what constitutes AI, here are three definitions that I've found useful:

- As the part of computer science concerned with designing intelligent computer systems; i.e., systems that exhibit characteristics that humans would consider intelligent if performed by a human.
- As a branch of computer science that endows machines with reasoning and perceptual capabilities.
- As the area of computer science that deals with problems that are incomplete in nature or have indefinite solutions.

All three definitions have in common the term "computer science"; it's important to recognize that AI is a scientific research discipline. It has both a practical and a theoretical side, and if you ignore the philosophical issues posed by the three uses of "computer science," practical AI boils down to programming. How does AI differ from conventional programming? Fundamentally, AI asks a programmer to look at programming in a new way. The main thrust is towards symbolic rather than numeric processing and towards introducing a degree of tolerance toward errors and imperfect knowledge prompted by the use of symbols, with all the human inaccuracies, fuzzinesses and frailties they suggest. The programmer must replace the algorithmic view of computer programs and its attendant data/pro-

cedural orientation with a non-procedural view based on flexibility and the expectation of change. AI programming is concerned, essentially, with mental activity.

This might suggest the kind of dreaming that physicists, philosophers or artists do. But, like physics, AI has a hard and practical edge: We're starting to do things with AI that we can't do with other kinds of programming languages. Currently, the major areas of AI research are: game playing, automatic programming, deduction- and theorem-proving, knowledge representation, learning, natural language processing, abstract problem solving, visual and scene understanding, expert systems and robotics. Of these, all but the last two are essentially confined to the laboratory. The last two, however, are very much a part of the operational and data processing profiles of many firms. For the rest of this article, I'll examine the technology of expert systems, which definitely has left the laboratory and achieved the status of a potentially useful tool for practical data processing. Both the terms "expert system" and "knowledge-based system" tend to be used interchangeably. Leaving aside the issue of what is the difference, I shall use the term knowledge-based system, or K-B system for short.

**K**-B SYSTEMS ARE MADE UP of two parts: a knowledge base, in which facts and rules are stored, and an inference engine, which puts information into the knowledge base, uses the rules to draw inferences from the known facts, applies control or search strategies and synthetically produces meta-rules based on established ones. The knowledge base and inference engine correspond with what we mean when, conventionally, we speak of data and program (see *Figure 1*).

This separation delivers flexibility, since facts can be used in more than one way: generality, since any fact or rule can be encoded; additivity, since new facts and rules may be

added in any order; and a transparent line of reasoning, which can be displayed online to explain the system's actions.

The inference engine effectively is a black box provided by the toolsmiths who create any particular system. The inference engine determines the format and structure of the

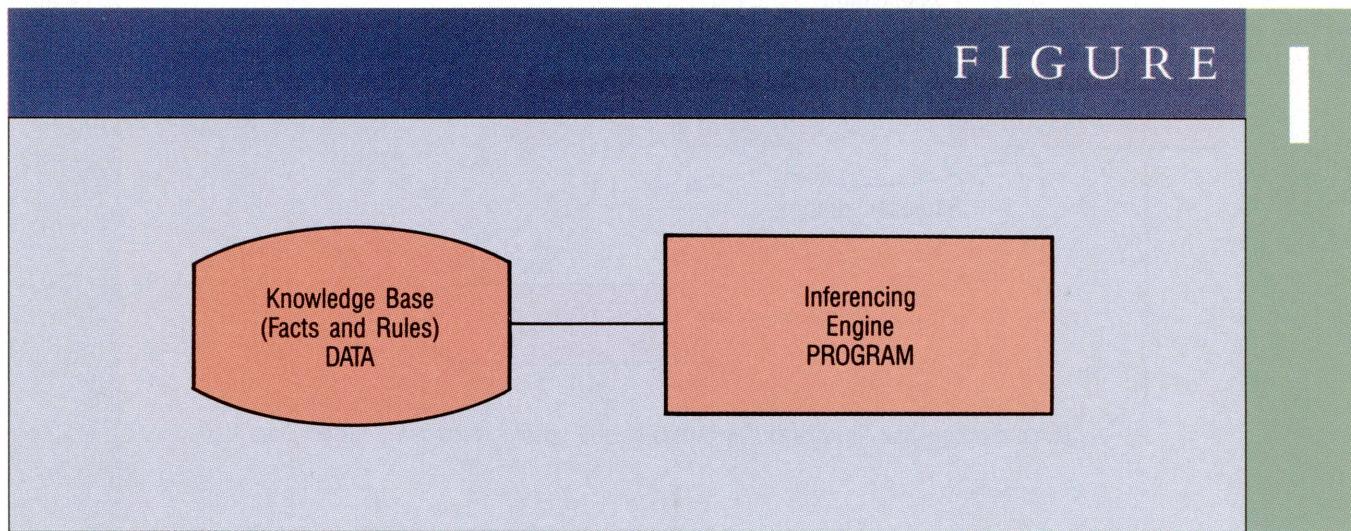
**Artificial Intelligence (AI)**  
really is one of  
many ways in  
which the future  
of computing is  
becoming the present.

knowledge base, which is the only area of the system that a developer is allowed to touch.

Typically, a K-B system development tool provides a specialized developer's workbench which enables the developer to create, edit, test and compile both one or more knowledge bases and an application-specific user interface. The end user of the system will see only the specialized user interface provided by the developer, which may or may not allow the knowledge base to be changed, depending on the nature of the application.

At present, there are only two ways to obtain an inference engine: Buy a complete K-B system development and runtime tool (often called a shell), or build one from scratch. Scratch-

FIGURE



*Generic knowledge-based system.*

building requires substantial expertise and pretty well mandates the use of a symbolic programming language such as PROLOG for prototypical development, even if the final engine can be recast into a conventional procedural language. If efficiency is an issue, the application requires specialized inferencing capabilities, or more than trivial interaction with conventional programming environments is required, this still probably is the only viable approach. However, this will change as new and substantially more sophisticated K-B system development tools appear in an increasingly competitive marketplace.

One of the big advantages of K-B systems is that a developer need not know what to do first — the “programmer” can be creative, adding rules as they loom in the imagination. This doesn’t mean that all the hard-learned software engineering techniques developed for procedural programming can be abandoned, but it does provide a much more flexible mechanism. Of course, a by-product of this flexibility is a significantly increased difficulty in testing and ensuring both correctness and completeness of the knowledge base.

Underlying this flexibility are the three key concepts: knowledge, deduction and search (see *Figure 2*). These form

the theoretical basis of the structure of K-B systems and, indeed, of much of AI research.

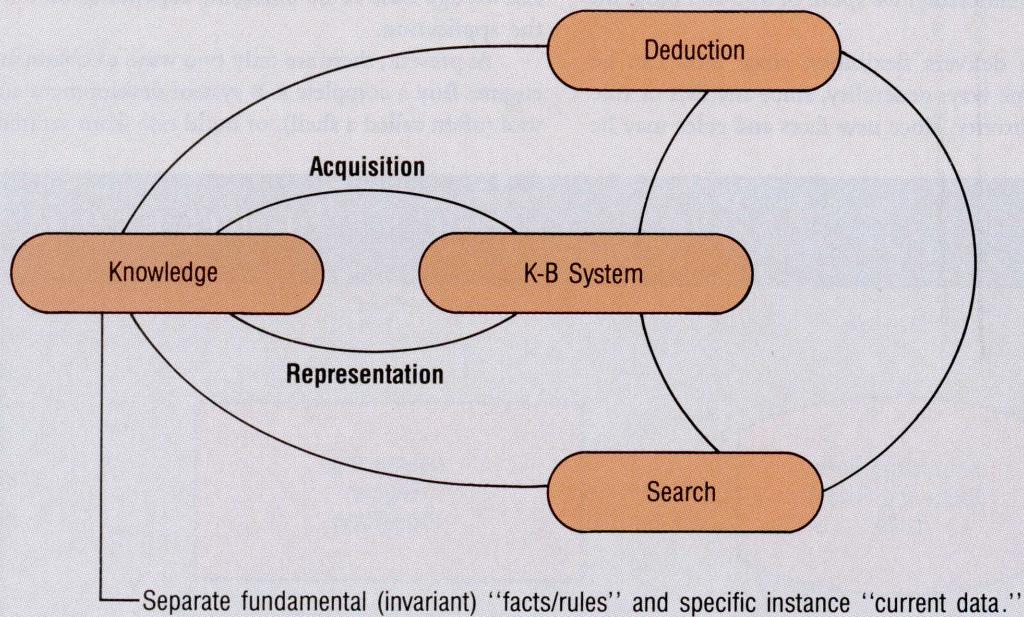
The search operation consists in the finding and presenting of pieces of information chosen according to criteria that follow from facts and rules. Deduction points to the ability of the K-B system to use facts and rules to draw conclusions and present the user with a new set of information.

Knowledge consists in the facts and rules initially entered in the K-B system, plus those that the system generates. Two points with respect to this knowledge: First, an ongoing problem is to show the relationships between pieces of knowledge. The structuring conceptual tool of choice is an inheritance hierarchy or network, where one piece of knowledge can point to others. Second, the cleavage between knowledge-based and conventional programming occurs where the knowledge required for a given application is completely contained. If the knowledge base can be determined to be complete, meaning that there are no missing pieces and the rules cover all possible situations, the knowledge-based mechanism can be abandoned in favor of a conventionally programmed implementation.

Why would anyone want to do this? Knowledge-based systems aren’t magical. An inference engine can be pro-

FIGURE

2



*Key concepts.*

grammed in PL/I or FORTRAN; you don't need so-called AI languages or machines to create them. Conversely, writing a program in PROLOG or LISP doesn't make it an AI application.

On the other hand, there's a price to be paid for the generality, flexibility and power of K-B systems: They're in-

We've found that  
the difference  
between a novice  
and a veteran user  
of a 4GL is that  
the veteran knows  
the tricks . . .

tensely cycle-hungry. For example, i80286-based machines like the IBM PC/AT have just about enough power to get a job started. The i80386-based and MC68020-based machines are much better. They're capable of delivering some heavy-duty knowledge-based applications. It appears that the latest generation of super-PCs will be the delivery vehicles of choice for K-B systems.

The HP 3000? Well, we'll use the Spectrum as a front-end! Seriously, there are severe limitations to the HP 3000's 16-bit stack architecture which render it inefficient for large-scale symbolic processing. This doesn't mean that it can't be used, rather that a serious knowledge-based application probably would demand a dedicated system. The recent appearance of tools such as Logicware's M-Prolog, with source-compatible versions for the HP 3000 and the Vectra, at least provide a comparatively inexpensive way for developers to start experimenting with symbolic processing.

**R**ESEARCHERS AT COGNOS (Ottawa, Ontario) adopted three propositions: that knowledge is open-ended, that people seldom insist on complete definitions when they start a job and, as additional definitions are required, people seek them. When you've assembled all the knowledge necessary to perform a task, you've satisfied the requirements of a conventional program.

Knowledge-based systems, then, can be used to assemble the elements that necessarily constitute the basis of conventional programs; they can be used as prototyping mechanisms.

One of our current internal projects is designed to pro-

duce demonstrable proof-of-concept prototypes. This project is a kind of software advisory assistant that's capable of answering questions phrased in a subset of English so that users can ask questions about our report-generating product, QUIZ. The knowledge domain is 4GL programming.

We've found that the difference between a novice and a veteran user of a 4GL is that the veteran knows the tricks, the rules of thumb that make the job easier to finish and finish well. It's this knowledge that we've encapsulated to make the project work. To date, we've developed a practical mechanism for knowledge representation and we've tapped some of our QUIZ experts for knowledge to feed the system.

The system, in its first iteration completed in October 1986, can answer 15 types of questions involving about 81 concepts. It teaches two lessons: that we have some distance to travel and that the proof of concept prototype does, in fact, work.

As our QUIZ experts continue to feed knowledge to the system, we expect a more fully elaborated product to teach further lessons. In particular, we're exploring just how the process of seeking information from an expert works and how best we can duplicate this via a computer terminal. On the other hand, the underlying technology in this project is expensive — it takes extensive hardware and software resources to run the current experimental prototypes and the product in its current form isn't intended for release.

So, we're taking two additional approaches to the problem, including one that deals with developing new, deep knowledge-based techniques that focus on a single topic and a second that explores the ramifications of intelligent discourse with the user.

Cognos researchers and developers are toolsmiths, not application-builders, which means that we're atypical tool users. Although we're not going to create tools for members of the AI community, we certainly expect to incorporate artificial intelligence techniques into the tools we make.

We need tools that won't damage our products' responsiveness. They must be well-built and easy to maintain. They also must integrate well with the tools we and others already have brought to market. We won't include them merely for the sake of claiming that some part of our product contains elements of AI.

At present, no knowledge-based system development tools on the market satisfy all these criteria. That tells us we should build our own, and our current research suggests that we'll start to harness AI techniques in the very near future. The future, it should be remembered, is a lot like the present — only longer. —Robert Stanley is a senior researcher at Cognos Incorporated, Ottawa, Canada.

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# D EBITS/CREDITS REVISITED

## An Update On Accounting Software

Mention accounting software, or even accounting in general, and invariably the first reaction is a big yawn. But, there really is a lot happening in the HP 3000 accounting software market, including the development of new ideas and approaches to solving users' accounting problems and the entry of new vendors with different strategies. Every company with an HP 3000 minicomputer is going to need a general ledger and other accounting software to manage and control its business, and these days there's a big choice.

Many interesting new ideas are coming from users, as they work with their accounting software and discover further improvements to their accounting operations or reporting. Other innovations spring from technological developments that make possible new capabilities. A major contributor in this realm has been the personal computer, and we can expect to see more impact by personal computers on minicomputer software in the near future.

**WHO ARE THE PLAYERS?** There are quite a few accounting software vendors for the HP 3000 market, and that's good for all concerned: Hewlett-Packard, HP 3000 customers and the vendors themselves. The wide variety of accounting software products strengthens HP's computer offering in the hardware market and gives users the knowledge that they can find a solid and affordable accounting software product to meet their particular needs.

But no one vendor offers software that's perfect, or even workable, in all customer sites. For example, smaller companies don't need the advanced capabilities of the high-end products and don't have the software budgets for them. Non-profit and government organizations require fund accounting and encumbrance cap-

bilities that aren't available in some packages.

The accompanying pie chart (see *Figure 1*) shows the estimated market share for the major vendors. The market leader, MCBA, was one of the earliest companies to provide accounting software for the HP 3000 and has used its extensive value-added distributor network to achieve its position. MCBA's accounting software is straightforward, well tested, and well documented. This fact, plus the market presence created by hundreds of MCBA distributors who are ready and willing to customize any module, have brought MCBA a lot of success.

ASK's strength is in the manufacturing software arena, where it has been very successful over the years.

Collier Jackson, which has also been in the HP 3000 accounting software market for a long time, chose a different path to success. It uses a direct sales force with offices throughout the U.S., and its products are oriented toward larger companies that require more advanced features and capabilities.

Relative to most of the other products, Hewlett-Packard's accounting software is a newcomer, but HP has wasted no time in gaining a firm position in this market with a full-featured product sold by its own sales force. Because some customers like one-stop shopping for both hardware and software, HP is positioned to wrap up sales before the other vendors are even aware of prospects.

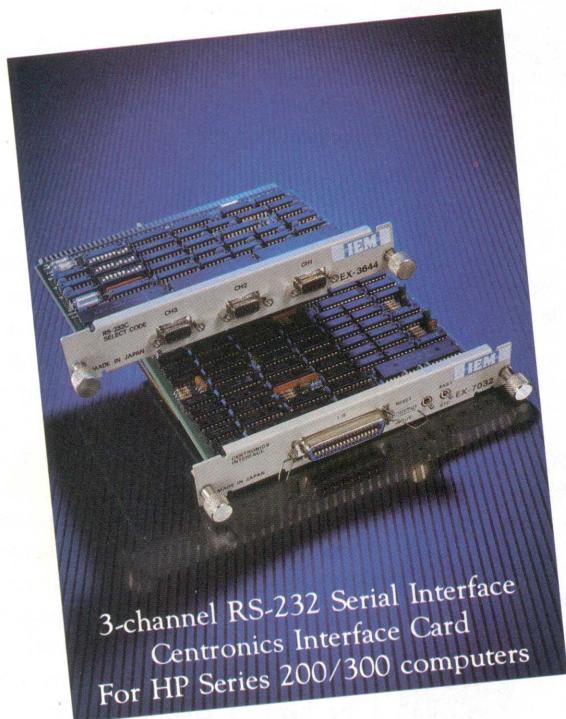
Cognos' full-featured offering, *Multiview*, is different from most other vendors' products, and has achieved a solid market position in a relatively short period of time. Smith, Dennis & Gaylord, Technalysis, SATCOM, Abacus, MTI and Cardinal have been working with the HP 3000 for a long time and have been very



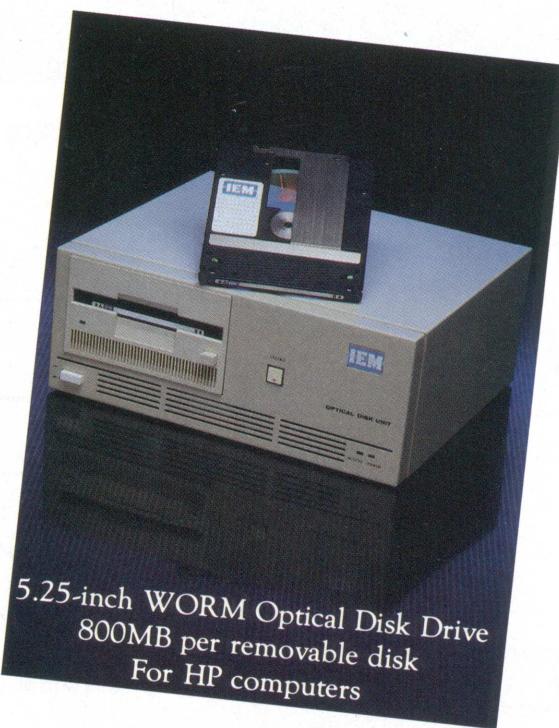
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**Robert E. Shelley**

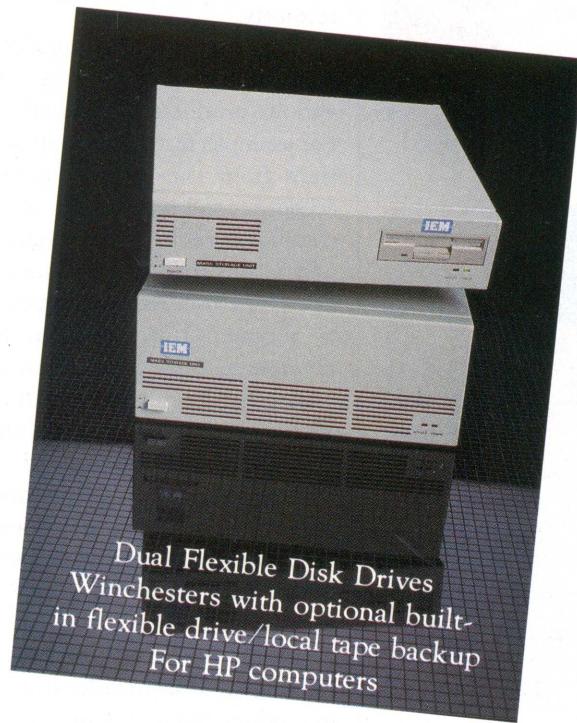
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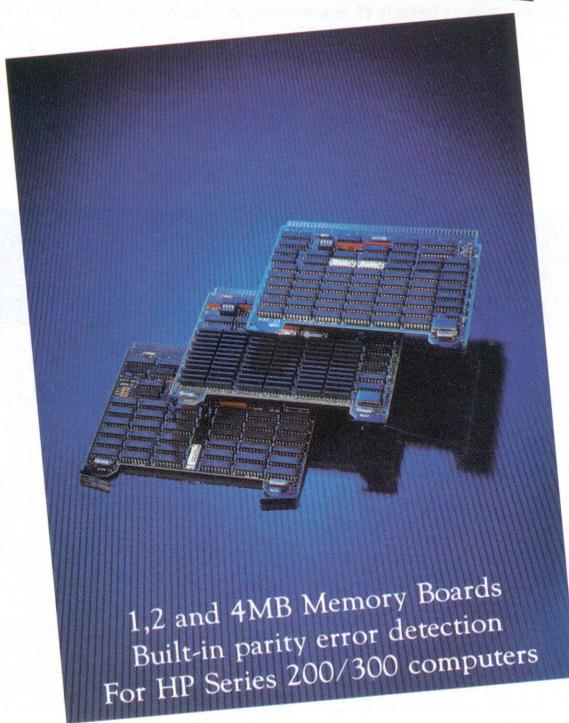
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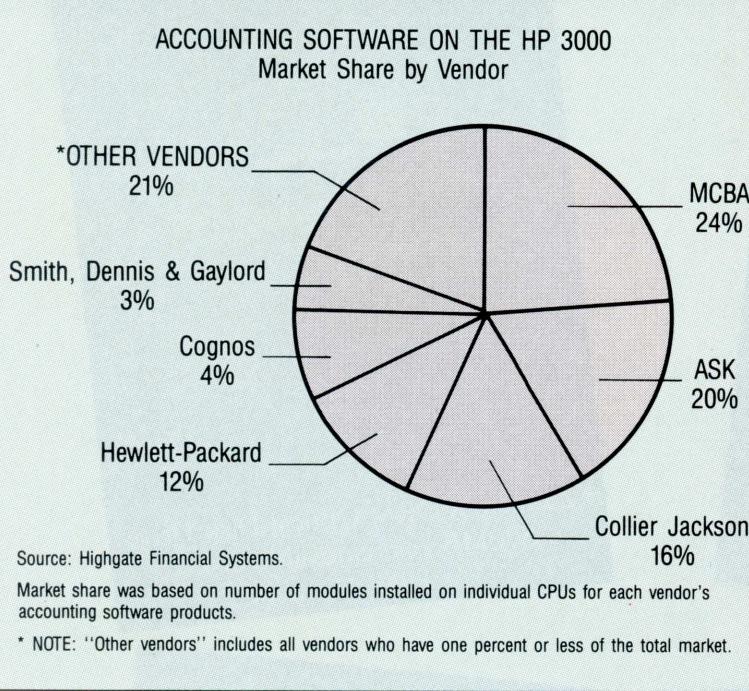
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## FIGURE



## FIGURE

Vendor	Market Share
MCBA	24%
ASK Computer	20%
Collier Jackson	16%
Hewlett-Packard	12%
Cognos	4%
Smith, Dennis & Gaylord	3%
Other vendors (*)	21%
<b>TOTAL</b>	<b>100%</b>

*Market share is shown clearly in table form.*

successful in the distribution and other vertical markets.

All of the other vendors have good packages to offer HP 3000 users, each with its own strategy for meeting customer needs.

ALTHOUGH EVERY VENDOR starts out with the HP 3000 and the MPE operating system, different products approach accounting problems in different ways. Among the major factors that drive product development are the nature of a vendor's customers and their special needs as well as the vendor's own technological capabilities and research and development budget.

Almost without exception, accounting packages provide some form of recurring entries, accrual reversals, batch balancing before posting, and an accountant-friendly financial report writer. Without these features, it would be hard to take a vendor's product seriously.

But there are other capabilities that aren't always present or that exist in various products to different degrees. For example, features that allow allocations from one or more department/account combinations to other such combinations vary from vendor to vendor. Some products have a method that allows the user to indicate percentages to allocate. Others, such as Mitchell Humphrey, allow for a percentage allocation that's recalculated each time the allocation is run (for example, allocating advertising expenses based on the monthly sales of each division). Some vendors allow allocation down to the department/account/product level, while others only go as far as the department/account level.

Multicurrency reporting is another feature that tends to differ from product to product. Many vendors simply don't offer it, probably because most of their customers haven't needed it or because their needs are met adequately by downloading files to a personal computer with spreadsheet software.

However, because more and more multinational corporations are using

minicomputers for accounting, a number of vendors, including Collier-Jackson and Smith, Dennis and Gaylord, are now offering multicurrency capabilities as an add-on feature to their general ledgers.

Fund accounting and encumbrance accounting are of little use to most corporations but can be important to non-profit or government organizations. Mitchell Humphrey and Computer Financial Services (CFS) are among the vendors offering these features. In evaluating accounting software, it's important to prioritize your needs. The name of the game is to meet satisfactorily as many of your requirements as possible at the best price. If your organization doesn't need fancy allocations, multicurrency reporting and fund accounting features, there's no need to pay for them. But when you need certain special capabilities, tell the vendors. Your list of potential products will shorten and your task of choosing accounting software will become a lot easier.

ALL HP 3000 USERS can take advantage of the capabilities provided by Hewlett-Packard that make this computer so attractive for business environments. An example is the IMAGE database language providing the foundation for almost all vendors' products. Likewise, all vendors can use the basic security mechanisms provided with the HP operating system. But beyond these areas, the vendors start to look different.

While most companies have chosen COBOL as the programming language for their systems, others have approached the development of their products differently. Smith, Dennis and Gaylord's software is written in BASIC, CFS uses RPGII, and both the *Vocom* and *Multiview* products use POWERHOUSE, the popular fourth generation language from Cognos. The vendor's choice of underlying language has implications for the cost and approach to customizing the software.

Of those companies using COBOL, not all employ VPLUS/3000 for screen

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handling. Most notably, MCBA, the market leader, chose not to go with VPLUS because by using COBOL alone for screen handling, the company could make its HP 3000 products work and look like MCBA's products on DEC, Wang and other computers.

System security also is approached in different ways by different vendors, although they all take advantage of the basic account and user passwords provided with the HP operating system. But additional security sometimes is desirable. Many products provide for functional security, that is, they allow the customer to determine which individual users can enter batches of transactions, run financial reports or planned payment reports, or print checks.

A few products provide security at the terminal level so that, for example, check production can be initiated only from the terminal in the accounts payable department. At the top end of the security spectrum is the need to control which users can enter data to particular department/account combinations. This feature might be required by a large, decentralized organization that wants to allow department A to enter transactions only to department A and its related accounts. Technalysis and Cardinal are among the vendors providing the widest range of security capabilities.

One of the more useful recent technical developments is the ability to share object code. This especially benefits growing organizations, because multiple installations of the same product, for example the general ledger, can be on the same HP 3000 computer while sharing the basic programs that drive the system, the object code.

Object code sharing can save a lot of disk space for organizations that need to operate this way, and by putting the accounting for different companies in different accounts of the HP 3000, overall processing time for all users can be improved dramatically. MCBA, Cognos

and Hewlett-Packard are on the list of vendors whose object code can be shared.

ALL SUCCESSFUL BUSINESS PEOPLE understand the need to take good care of customers. In the software business, this usually means good user manuals for your products, a training program for new customers, continuing education for existing customers' needs, new releases of your products to include bug-fixes and enhancements, and phone-in support for the inevitable

*... it's clear  
that there are as  
many innovative  
vendors as there  
are users . . .*

mistakes or misunderstandings that are part of working with computers. All vendors offer these basic services, directly and/or through their distributors.

Typically, the cost of basic support is charged to the customer on a monthly or annual basis. The support fee is often a percentage of the software license fee, usually between 10 percent and 20 percent per year. Some vendors drop the training fees involved in installing accounting software at a new site into the cost of the software while others treat this as an add-on cost. Any customization for a particular installation usually will be priced separately from the software license.

An important part of a vendor's support services involves staying in touch with customers as a group as well as individually. To do this, many vendors have encouraged, or even organized, users' groups for their products. National users' groups usually meet annually, but some products also have regional groups that meet more often. Interestingly, however, vendors selling through distributors and those focusing

on specific markets such as distribution often don't have users groups.

SPEAKING OF CUSTOMER SUPPORT, an innovation that probably was inevitable in today's video world is the advent of customer training video tapes. In a new release for one of its products, ASK recently included (for a modest extra charge) a video tape to teach users how to work with some of the system's new features. In time, more vendors undoubtedly will turn to videos as a training medium.

Another vendor, MCBA, now provides a menu-driven procedure for installing new releases of its products. This technique should decrease the number of calls the company gets from users doing these installations, which will benefit the customer as well as the vendor's customer support staff.

Many (although certainly not all) vendors have shifted their software license pricing to a CPU-related, sliding scale pricing. If the price of a general ledger package is X when it's going to run on an HP 3000 Series 70, then the price for the same product on a Series 42 would be less, perhaps 60 percent of X. Designed to keep the cost of software consistent with the cost of the hardware it runs on, this approach also reflects that the value of a software product is related to the number of users who can access it at the same time.

Another interesting trend, seen primarily on the newest software coming to market, is the full integration of accounting products. This means, for example, that as you're entering an AP voucher for payment and distributing it to the appropriate expense accounts, each of these entries is being recorded immediately in the general ledger. Of course, with integrated products you have to have the general ledger installed before other modules can be used, but many organizations are finding that this fully integrated approach provides the continuous, on-going consistency between subledgers and the general ledger.

that they prefer. Cognos' *Multiview* software is an example of a fully integrated system.

A major development with far-reaching implications is the increased sharing of data between accounting software on the minicomputer and on the personal computer. More and more, vendor-provided utility programs are available for downloading accounting balances to a PC so that they can be transferred into a spreadsheet for further analysis. DPAI, Collier Jackson, and many other vendors provide this capability.

Less common, but with interesting potential, is the ability to capture and edit data, perhaps budget data or even actual transactions, on the PC and then upload the data to the HP 3000 where it can be batched into the accounting database. This procedure relieves pressure on the HP 3000 by distributing data entry to PCs and allowing data entry to continue even when the HP 3000 is unavailable. It also enables geographically dispersed accounting operations to save on telecommunications costs by collecting accounting data locally and transmitting it to the HP 3000 via file transfer. MCBA has even developed a PC version of its accounting software, although it has left to its value-added resellers the development of software to transfer data between minicomputers and PCs.

Looking at the whole HP 3000 accounting software market, it's clear that there are as many innovative vendors as there are users, who keep coming up with new twists for portraying and manipulating debits and credits. It may be necessary in years to come for organizations to develop custom sub-ledgers. But given the power and flexibility of products offered to HP 3000 users, it's almost unimaginable for anyone to build basic accounting software from scratch. —Robert Shelley is president of *Highgate Financial Systems*, Emeryville, CA.

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# LIGHTS AND MIRRORS

## The Mysteries Of Laser Printers

Laser printers have been a remarkable boon to the entire computing field and have spawned at least one new application: desktop publishing. But that doesn't mean we users feel entirely comfortable with them yet. No clear standards exist to calibrate a laser printer's performance, and generally usability may be a very different quality from speed or number of fonts a printer handles.

The workings of the tractor feed on the old dot matrix printer are obvious, but what do we know about things like *fusers*, *drums* and *laser beams*? What do we need to know to better understand the laser printers we have and how to best select the next one?

A little time with an article like this one can clear up some of the mysteries of the technology, but one thing we can't explain is how we ever managed without them. Page lasers from different manufacturers may use slightly different technology, so we've tried to address our thoughts to the most common elements.

Laser printers seem magical sometimes, and the irony is that most of their tricks really are done with lights and mirrors.

### Mystery #1: How Do Laser Printers Work?

The "laser" in laser printers is an acronym for Light Amplification by Stimulated Emission of Radiation. Although the energy in medical lasers is used to cut and stitch, and the military would like to use lasers to blast holes in enemy missiles, the laser in a laser printer is used in quite a different way. Light is used to etch an electrostatic charge that attracts toner to blank paper in desired patterns. This technique makes the laser printer a close cousin to the copier machine. Thus, lasers are nothing more

than concentrated, coherent light beams, and in laser printers, the beam never touches the paper.

How the data gets into the machine is where copiers and lasers differ. Copiers, of course, scan a preexisting image and duplicate it. A laser printer has to do something much more complicated: It must create the image from signals sent by the computer and interpreted by the *controller*, essentially the "brains" of the printer.

#### Step 1. Controller receives data.

The controller has a lot to do, like separating text from commands, managing fonts in RAM, and deciding what to "write." The programs to do so are contained in *firmware*. Most laser printers print 300 dots per inch, meaning all data eventually is broken into lines of dots 1/300 of an inch thick and sent to the optical unit of the printer engine.

#### Step 2. Drum is exposed to light beam.

Once the controller has a complete definition of an entire page, several things happen at once. This is where the mirrors come in. First, the corona wire energizes the drum with an electrostatic charge. Then the optical unit's semiconductor laser creates an infrared beam that "discharges" or "writes" information onto the photosensitive surface of the drum as it revolves. The mirror sweeps the beam across the rotating surface of the drum, painting the entire drum.

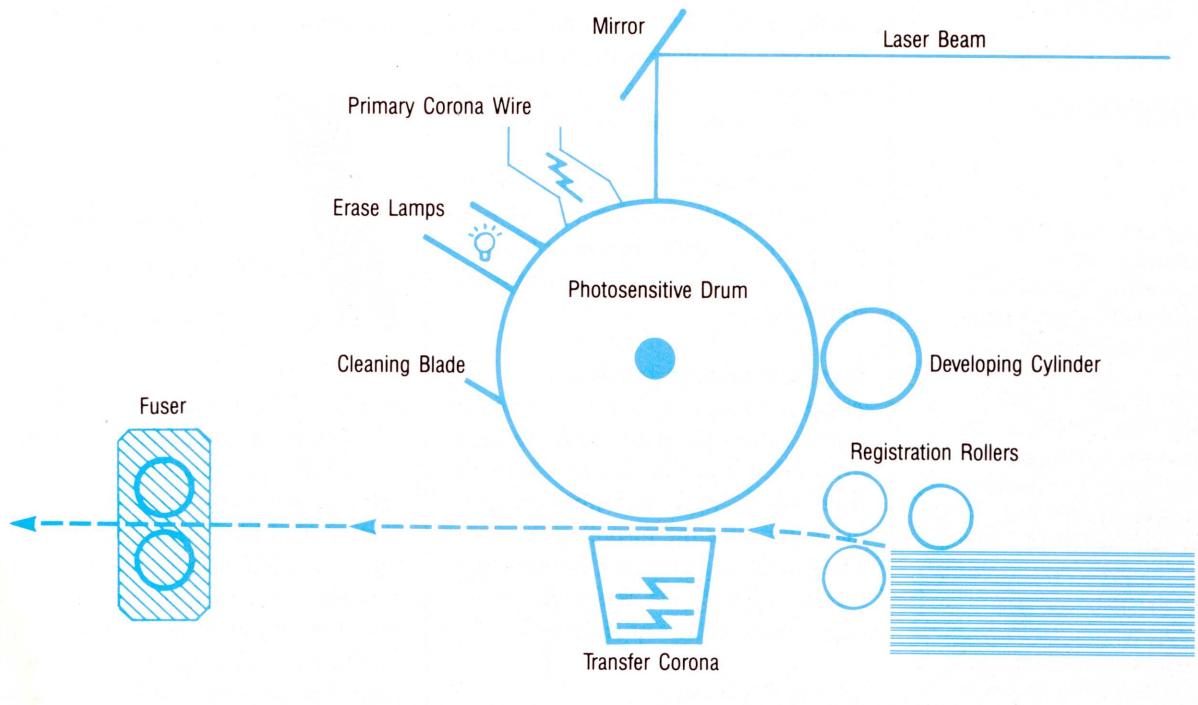
If the beam writes information onto (discharges the electrostatic particles from) areas where the black image will appear, this is called "black writing" in industry jargon. If the beam discharges the particles from those areas where writing won't appear, that's called "white writing."



## DESKTOP PUBLISHING

John Vornholt  
Carolyn Meskell  
Ashley Grayson

### Image Formation System



Because characters printed by laser printers are made up of dots (300 dpi), there's a small difference in the appearance of characters written by white writers and black writers, so small a difference as to be considered unnoticeable for most applications. The white writer produces richer, more uniform blacks and would be good for reproducing silhouettes; the black writer, cleaner fonts in small point sizes. The HP LaserJet printers are black writers.

#### **Step 3. Toner is applied to drum.**

In the developer unit, toner and a developer compound are either pre-mixed (as in the cartridges required for

the HP LaserJets and other Canon-engine and Ricoh-engine printers) or mixed at the time of use (such as in the Toshiba engine used in the PageLaser12 and DataProducts LZR 1230) and released onto the drum. The mixture "sticks" in the desired image, being attracted either to the area written by the laser (black writer) or the area not written by the beam (white writer).

Toner and developer obviously are the most used consumable supplies and have to be replaced or recharged every 5,000 to 10,000 pages. Newer printers issue a warning when their toner is getting low, but the appearance of the document may warn you even sooner. If the output grays out (looks pale) or develops pale vertical stripes, the

toner may need to be replaced. Shaking the toner cartridge according to the vendor's instructions may improve the quality temporarily.

**Step 4. Toner is transferred to paper.** With the drum now impregnated with toner, a strong reverse charge, the *transfer charge*, is applied to the paper as it approaches the drum. When the drum and paper meet, the toner is attracted away from the drum and onto the page. The process is now almost complete, except that it must be repeated, perhaps as many as two and a half more times before the page is completely printed.



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Consider the fact that the length of a standard page is 11 inches, and the circumference of the drum in the HP LaserJet Series II is approximately three inches. To print an entire page, the drum must be cleaned, recharged, rewritten, have toner applied and transfer the toner to the next section of the paper several times.

At each of the cycles described above, excess toner is removed from the drum by a cleaning blade. A discharge lamp removes any remaining charge from the drum, preparing it to start the cycle anew.

All of these steps — charging by the corona wire, discharging by the laser beam, toner to drum and toner to paper transfers and clean-up — are happening simultaneously.

### Step 5. Finishing touches.

Another charge, called the *separation charge*, causes the paper to be repelled from the drum. Rollers carry it to the *fuser* where heat and pressure permanently affix the image to the page. The toner and developer compound is literally melted into the pores of the paper, there to remain forever.

### Step 6. Clean-up.

Before the completed page leaves the printer, it passes a metal static brush which removes any remaining static charge. This ensures the paper will exit the machine and stack properly.

With all that going on, it's a wonder laser printers are so fast — usually. Desktop publishing relies heavily on bit-mapped graphics, downloaded fonts and other beautification measures that tax the resources of the printer. This results in The Second Great Mystery of laser printers.

### Mystery #2: Why Are They So Slow Sometimes?

We wink knowingly at one another when we see ads for a laser printer claiming 10 pages per minute, or 12 or 18. Even Hewlett-Packard's more reasonable claim of eight ppm brings a wistful sigh. Laser printers do print that

fast when they're printing multiple copies of a page already in memory, or when they're printing a page with simple formatting in a standard font, like Courier. They don't do as well with desktop publishing and general graphics applications.

Serial lines and even paralleled connections sometimes are woefully inadequate for the transmission of the millions of bits necessary for full-page



. . . it's a wonder  
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so fast — usually.

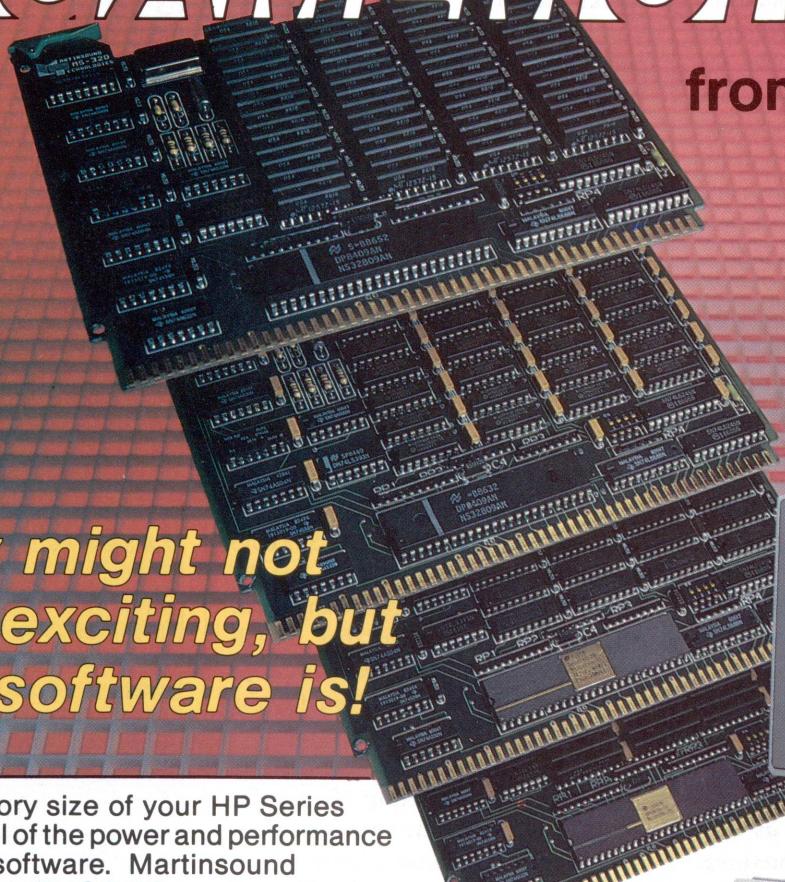
graphics. Plus, the laser printer has lots of work to do assembling all of it.

Unlike a dot matrix printer, which starts printing as soon as the first data is received, a laser printer waits until its memory is full, usually 512K to 2 MB, if it doesn't receive a form feed command first. Then it pauses the computer, prints what it has, and waits for the rest of the page. The page, obviously, isn't ejected until the last dot is printed. Exactly how this happens depends on how much memory is installed in the printer, whether software fonts have been downloaded into the printer, and how complicated is the image being printed.

The most demanding word processing with five or six soft fonts isn't likely to tax most laser printers, but if large font sizes are required (30 point and up) or if much graphics is required, the printer may run out of memory. This is why laser printer vendors offer several memory upgrades. Generally speaking, laser printers with less than 512 KB of memory are useless for any kind of graphics or desktop publishing.

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megabyte worth), and it can result in a couple of minutes' wait for complex pages. The wait is worth it when the finished product looks so good, but could it look even better or print faster? Many users are confused and intimidated by the claims for PostScript and other page description languages, and they could use some demystifying.

### Mystery #3: What Is PostScript?

PostScript (Adobe Systems) is the best known of several page description languages (PDL). A PDL is a programming language like BASIC, PASCAL, or C; but instead of programming the computer, it programs the printer. Interpress, the original PDL, was developed by Xerox for use on its high-end office automation systems, so terminals could drive different printers in a networked environment.

Interpress probably is still the best printer management system for a networked environment. The key concept in Interpress, not present in any other PDL, is that the computer (and its software) defines a *document*. Interpress printers attached to a network can do on-demand printing without the further assistance of the originating computer. PostScript was developed by Adobe Systems specifically for the personal computer environment in which the laser printer is directly controlled by the computer that is requesting the printing. PostScript defines a *page*.

A particular PDL doesn't improve the resolution, speed or any operational aspect of a given printer any more than another. PostScript may make additional fonts available to the user. But printers that "speak" PostScript are more expensive, because of the separate interface required and the accompanying circuitry.

Many common software programs (spreadsheet, database, etc.) don't support PostScript. However, desktop publishing programs such as Ventura Publisher (Ventura Software, Inc.), PageMaker (Aldus Corp.), etc., usually do support it. Ventura Publisher also

speaks Interpress.

Those same DTP packages also support all the members of the HP LaserJet series via Hewlett-Packard's Printer Control Language (PCL), and the results are virtually identical. PCL is a standard developed by HP to control the LaserJet family of printers. Notice the difference in focus: PCL is used by a program to control an HP LaserJet; PostScript is a formalism agreed on for defining the look of a page to simplify the interface between a layout program and the printer driver.

Hewlett-Packard recently developed enhancements for the LaserJet family based on Imagen Corporation's DDL. DDL is yet another PDL. Since no one but HP backs DDL, it has lost the battle of the page description languages. HP also has announced that it will cooperate with QMS to offer PostScript via a QMS-developed add-on for the LaserJet II.

A number of other third-party manufacturers are offering add-ons for the HP LaserJet family that turn older models into PostScript printers. They cost around \$2,000 and require physical modifications to the HP LaserJet or LaserJet+ (some can't be installed on the LaserJet II). Because of these modifications, they void the warranty. They also may add an option card into the buyer's PC.

However, in our humble opinion, whether the software speaks French or Chinese to the printer is of no real importance, as long as the printer can interpret correctly and do what it's supposed to do — print — which we've learned, like magic, isn't as simple as it looks! — *Ashley Grayson is the founder of ADG, a marketing services organization based in San Pedro, CA. John Vornholt is a project manager for ADG and personal computer enthusiast. Carolyn Meskell is a market researcher and editor at ADG. These authors from ADG will be contributing articles on desktop publishing on a regular basis. If you have a specific question or topic you'd like them to cover, contact the Editorial Dept., HP PROFESSIONAL, P.O. Box 445, Spring House, PA 19477.*

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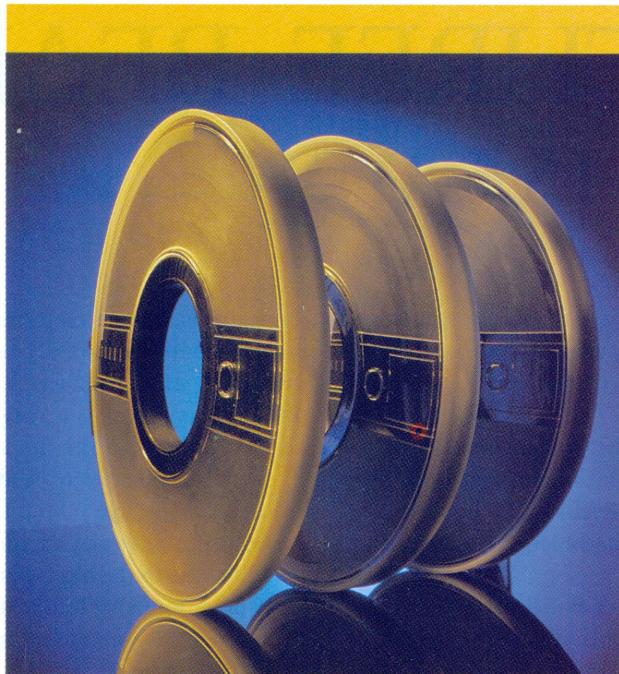
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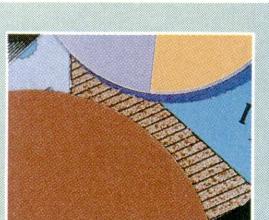
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# **T**HE THREE BEARS OF IMAGE

## **Understanding Integer Keys And How IMAGE Handles Them**



### **DBMS**

**Fred White**

Software designers, whatever the product, hopefully provide a variety of features that they believe are important to user acceptance of the product.

In many cases, the implementation of a feature is optimized for the use envisioned by the implementors. Conversely, the implementation may be sub-optimized for use other than as intended.

Traditionally, product manuals seldom, if ever, include motivational discussions of product features so that users aren't warned about sub-optimal uses of the product features.

In some cases, the sub-optimal use of features may have no noticeable effect on throughput or response time. In others, the effect may be disastrous.

Two features of IMAGE/3000 whose sub-optimal use can be disastrous are "integer keys" and "sorted paths." For the purpose of this article, these two represent, respectively, PAPA BEAR and MAMA BEAR. Each is a very deep pitfall and extricating yourself from either can be very expensive.

BABY BEAR is represented by "paths," another feature whose misuse, while normally not disastrous, may have a negative effect on response time and/or throughput. A discussion of the use of paths is included to justify the title and because it should be of general interest.

"DETAIL" DATASETS WERE INTENDED as repositories for records having generally no unique identifying characteristic (field value) and for which the primary access method would be sequential.

Each detail dataset starts as an empty file of a size large enough to meet its capacity

requirements. IMAGE keeps track of the highest record number (initially zero) assigned to any record of the dataset as a result of a DBPUT. This serves as a "high-water mark" and is analogous to the file system's EOF.

Stated another way, a detail dataset is similar to an ordinary MPE file in that each new record is assigned an address calculated by adding one to the high-water mark. When this is done to an MPE file, MPE adds one to the current EOF pointer and appends the new record.

IMAGE, however, provides for the automatic reuse of space that results whenever a record is deleted. It keeps track of the reusable space by means of a push-down stack. It maintains a pointer to the newest member of this stack and each member points to an older member deeper in the stack. DBPUT increments the high-water mark and assigns the new value of the high-water mark as the address of the new record.

"Master" datasets were intended as repositories for records having a unique identifying characteristic (field value) and for which the primary retrieval technique would be dependent on this unique value. The IMAGE manual refers to this as calculated access.

After much discussion, it was decided that two distinct "flavors" of calculated access be provided: one over which the user essentially would have no control and which would calculate record addresses via a hashing algorithm whose objective was to achieve a nearly uniform distribution of addresses in the face of random or non-random key values, and another over which the user essentially would have absolute control in that the low-order 31 bits of the key value would determine the desired address (modulo the capacity).

For those of you familiar with "direct ac-

*Good uses of integer keys require the designer's awareness of the effect of the key values and the capacity on the address assignments made by DBPUT over the life of the application.*



cess" methods, this latter capability can be viewed as a generalized "direct access" method: generalized in the sense that addresses greater than the capacity aren't considered invalid, but instead, are reduced modulo the capacity. IMAGE does this by:

- subtracting one from the 31-bit key value,
- dividing the result by the capacity to obtain the positive remainder, and
- adding one to this remainder.

It was further decided that this "direct access" technique would be used whenever the search field was defined as an item of type I, J, K or R (all of which are of binary format) while "hashing" would be used whenever the search field was defined as an item of

type U, X, Z or P (none of which is of binary format).

For all of the "direct access" type keys, IMAGE treats the low-order (right-most) 31 bits as a positive integer in calculating the record address. For this reason, these keys have been dubbed "integer" keys as a way to distinguish them from "hashed" keys.

Space allocation for master datasets is completely different from that described for detail datasets. In effect, a master dataset starts out with the high-water mark equal to the capacity and DBPUT never appends records. Instead, the record space starts out as entirely reusable. No "delete chain" is maintained for master datasets. Instead, IMAGE relies on a "bit map" that's maintained at the front of each block of each dataset. For master datasets, DBPUT calculates the primary address (as described above) and, after verifying that the key value

is unique, attempts to place the new record at the primary address.

This attempt will succeed if and only if this new record has no synonyms. Otherwise, DBPUT assigns a secondary address physically near (hopefully) the primary address. It finds such a hole by means of a sequential (and cyclical) search starting with the block containing the current end of its synonym chain. In a master dataset that isn't too full and where existing records are not "clustered" (i.e., nearly uniformly distributed) and where the "blocking factor" isn't very small, this search might require zero, or only a few, disc reads.

This technique assigns synonyms to the same block or to neighboring blocks, thus minimizing I/O during DBPUTs, DBFINDS and keyed DBGETs.

Having covered the pertinent differences between detail and master datasets, let's proceed to a discussion of the path feature.

Under IMAGE, a path is a relationship between a master dataset and a detail dataset. The relationship is 1-to-N (where N varies from zero to 64,535) in the sense that each master record is related to N records of the detail dataset and that each record of the detail dataset is related by this path to exactly one record of the master dataset.

The N detail records related to a common master record are referred to as a chain since IMAGE links them together with backward and forward pointers. One end is referred to as the "beginning-of-chain" and the other is referred to as the "end-of-chain." New records are added to the "end-of-chain." IMAGE maintains a chain length count and pointers to the beginning- and end-of-chain in this common master record.

The common master serves as a locator record (via a DBFIND) to the corresponding detail chain. This is analogous to using the card catalog in a library to locate all books written by a particular author.

The fact that a detail dataset can have paths to more than one master dataset is analogous to the books in a library being referenced by other card catalogs such as Title or Topic.

This, together with the fact that IMAGE permits master datasets to have paths to more than one detail and have more than one path to any detail make IMAGE (along with the AUTOMATIC master feature) a very flexible two-level network structure database management system.

MY FIRST LIVE ENCOUNTER with a misuse of integer keys arose in 1978. One Friday, I received a phone call from an insurance firm in the San Francisco Bay Area. I was told that their claims application was having serious per-

formance problems and that, in an attempt to improve the situation, they had, on the previous Friday, performed a DBUNLOAD, changed some capacities and then started a DBLOAD that didn't conclude until the early hours of Tuesday morning!

They were a \$100,000,000-plus company that couldn't stand the online response they were getting and couldn't afford losing another Monday in another vain attempt to resolve their problems.

Investigation revealed that claims information was stored in two detail datasets with paths to a shared automatic master. The search fields for these three datasets was a double integer key whose values were all of the form YYNNNNNN (shown in decimal) where YY was the two-digit representation of the year (beginning with 71) and where each year NNNNN took on the values 00001, 00002, etc., up to 30,000.

Although the application was built on IMAGE in late 1976, the earlier claims information (from 1971 through 1976) was loaded to be available for current access. I don't recall the exact capacity of the master dataset, but for purposes of displaying the nature of the problem (especially the fact that it didn't surface until 1978), I'll assume a capacity of 370,000.

Although the number of claims per year varied, the illustration also will assume that each year had 30,000.

The first claim of 1971 was claim

number 7100001 which, using a capacity of 370,000, IMAGE would assign a primary address of 70,001. This is because 7,100,001 is congruent to 70,001 modulo 370,000. The 30,000 claims of 1971 thus were assigned the successive addresses 70,001 through 100,000.

Similar calculations show that the claims for each year were stored in groups of successive addresses as shown in *Figure 1*.

Note that no two records had the same assigned address, thus there were no synonyms and all DBPUTs, DBFINDs and keyed DBGETs were very fast indeed!

Now comes 1978. Unfortunately, 7,800,001 is congruent to 70,001, so the first DBPUT for 1978 creates the first synonym of the master dataset. It is, in fact, a synonym of claim 7100001. Recalling that DBPUT finds an alternate location by means of a serial search, DBPUT then searches the next 60,000 records before it finds an unused address at location 130,001. Even with a blocking factor of 50, this would require 1,200 additional disc reads which would make each DBPUT up to 200 times as slow as those of previous years!

Note that the next claim of 1978 (with claim number 7800002) is congruent to 70,002, so it's a synonym of 7,100,002 and also leads to a serial search that ends at location 130,002! Thus, each successive DBPUT results in a search of 60,000 records, 59,999 of which it had inspected during the preceding DBPUT.

FIGURE

Year	Claim Numbers	Assigned Addresses
1971	7100001-7125000	70,001-100,000
1972	7200001-7230000	170,001-200,000
1973	7300001-7330000	270,001-300,000
1974	7400001-7430000	1- 30,000
1975	7500001-7530000	100,001-130,000
1976	7600001-7630000	200,001-230,000
1977	7700001-7730000	300,001-330,000

PAPA BEAR had claimed another victim. The designer of this system unknowingly had laid a trap that would snap at a mathematically predictable time, in this case 1978. After struggling

still would arise if the capacity were merely changed, for example, to 3,700,001.

It should be apparent by now that designers may avoid the clutches of

adding a new record to a sorted path, DBPUT starts its search for the appropriate point of insertion at the end of the chain and then searches the chain backward until it encounters a record whose sort field(s) value is not greater than that of the record being added.

For input records whose sort field values are randomly offered, the expected number of records to be searched is one-half the length of the chain. When the chain is 20 records long, the search will cover 10 records on the average. When it becomes 30,000 long, the search will cover 15,000 records on average!

For a file with 40,000 records to be sorted into one chain, the expected number of reads to cover all searches is approximately 400 million with the last record alone expected to take 20,000!

The blocking factor of the input tape was 200. No wonder the tape hadn't moved for 10 hours.

To avoid the clutches of MAMA BEAR, avoid using sorted paths if the chains are very dynamic or very long. The more dynamic they are, the shorter they should be; the longer they are, the less dynamic they should be. The term dynamic is used here to refer to the relative frequency with which entries are added and deleted.

Contrary to the many warnings you may read against using sorted paths, there are occasions when their use is infinitely better than any other option.

HP's Corporate Parts Center (Mountain View, CA) used a sorted path in its back-order dataset. The search field was the part number and the sort field was a priority assigned by order-entry personnel in such a manner that the highest priority back-orders were at the front of the chain.

When new parts were received, a clerk at the receiving dock would enter the part number and quantity at a terminal. The program then would per-

## *To avoid the clutches of MAMA BEAR, avoid using sorted paths if the chains are very dynamic or very long.*

with this problem for months, the user ultimately escaped from PAPA BEAR by converting to "hashed keys" (in both the database and the application modules), a very expensive conversion.

Note that the problem wasn't a synonym problem in the sense that synonym chains were long, nor was it a "fullness" problem since the master dataset was less than 57 percent full when PAPA BEAR struck.

The problem was due to the fact that the records were maximally clustered, whereas DBPUT's space-searching technique for masters is optimum only under (nearly) uniform distribution assumptions.

Note that the performance of DBFIND and DBGET was excellent since the maximum synonym chain length was two.

Another much more shallow pitfall would've been designed if, in the above example, the claim numbers had been of the form NNNNNYYY with the same capacity of 370,000. In this case, the performance of DBPUTs, DBFINDs and keyed DBGETs all would degrade over time, but would never reach the disastrous level of the DBPUTs of the example. In this case, the degradation would arise due to the length of synonym chains and due to local clustering.

This modest pitfall could be eliminated by changing the capacity, for example, to 370,010.

Note, however, that this problem

PAPA BEAR by carefully (mathematically) inspecting the consequences of the values of their choice of integer keys in relationship to their choice of master dataset capacity.

MY FIRST LIVE ENCOUNTER with a misuse of sorted paths arose in 1975. The facts surrounding this incident were told to me by Jonathan Bale who was still on the IMAGE project. Neither one of us remembers the exact numeric details, so I've used poetic license by making up numbers that seem to be reasonably close to the actual ones involved in the incident.

The user had created a database containing one automatic master dataset and one detail dataset related by a two-character key and where the resulting path was sorted by some long-forgotten field(s).

The user had written a program that read a record from an input file, added two blank characters to serve as the search field and then performed a DBPUT to the detail dataset. This was repeated for all records of the input file.

At the time Jon received a phone call, the tape hadn't moved for around 10 hours and the program already had been running for at least 30 hours.

On inquiry, Jon learned that the input file contained over 40,000 80-character records and that the user was using IMAGE to sort these records!

This is an extreme example of a sub-optimal use of sorted paths. To see this, it's important to know that when

form a DBFIND with that part number on the back-order dataset followed by a sequence of chained reads. For each record in the chain, a packing slip would be printed showing the quantity and destination and the record then was

fields of the record are ordered to take advantage of IMAGE's extended sort to include component option and quantity.

This "clever" design together with a recursive procedure enables the application to provide online single-or multi-

sum frequency of use can't exceed 100 percent.

As illustrated in the examples, sorted paths can provide benefits critical to some applications. For instance, the application may not have to search the entire chain or it may simply be easier to program and/or marvelously faster as with the bill-of-material example mentioned above.

The overhead for paths mentioned in reference to DBPUTs and DBDELETEs is also proportional to their frequency of use. In other words, this overhead is less of a consideration for relatively static datasets than for relatively dynamic datasets. So, additional paths for static datasets have less DBPUT and DBDELETE performance costs than on dynamic datasets.

GOOD USES OF INTEGER KEYS require the designer's awareness of the effect of the key values and the capacity on the address assignments made by DBPUT over the life of the application.

For certain applications, the use of sorted paths isn't only highly recommended, but may, in fact, be critical to success. The back-order application described earlier was implemented by Jonathan Bale in 1974 and the bill-of-material application was implemented by myself, also in 1974. In both cases, sorted paths were a must.

In general, the rule for a path is: "When in doubt, leave it out." If leaving it out proves to be a mistake, you can be sure that someone will call it to your attention and then (with the help of Adager) you may add it without impact on any application module. On the other hand, if providing it proves to be of little benefit, no one will tell you, and removing it undoubtedly will have dire consequences on some application module(s). —Fred White, Adager, Antigua, Guatemala.

## *For certain applications, the use of sorted paths isn't only highly recommended, but may, in fact, be critical to success.*

deleted. This process was repeated until the chain was empty or all received parts were accounted for. In the former case, an additional shipping slip was printed so that the remaining parts would be delivered to inventory.

This "online" technique eliminated unnecessary shipment of parts to inventory, minimized parts handling, facilitated shipments and minimized errors.

Even though the chains were sorted, most back-order chains were either empty or had only a few entries so that adding new entries was never really slow.

Another even more outstanding use is available to order processing systems where each subsystem (or part) in a master dataset is related to its components in a detail dataset by the part-number of the subsystem (or part). The component-numbers in each detail record also are present as part-numbers in the master dataset. Each of these in turn may be related to other components in the detail dataset. In other words, the "parent-child" relationship implicit in the concept of "component" is recursive.

The detail dataset here is related to the master via a parent-number field and is sorted by component-number. The

level, fully indented, bill-of-material explosions with the components at each level in component-number and component-option order. No sorting is required and the performance of the explosion is limited by terminal speed.

Although many people may recommend that you avoid sorted paths, try implementing either of these applications without them. Response time would be somewhere between bad and disastrous.

There really is a place for network databases and sorted paths.

ONE OF THE REASONS for defining a path is to provide rapid access to all of the records in a detail dataset having a common search field value.

In general, a path should be defined only if:

- it is necessary for the application,
- its speed of access is better than a serial search and it's frequently used, or
- its speed of access is so much better than a serial search that it's cost effective even if it's seldom used.

Remember that each path you define causes additional overhead for DBPUT and DBDELETE and requires more disc space.

In considering frequency of use, remember that if you have 16 paths, they can't all be used more than 6.25 percent of the time, so any arguments offered by the proponents of a path or paths should be evaluated in light of the fact that the

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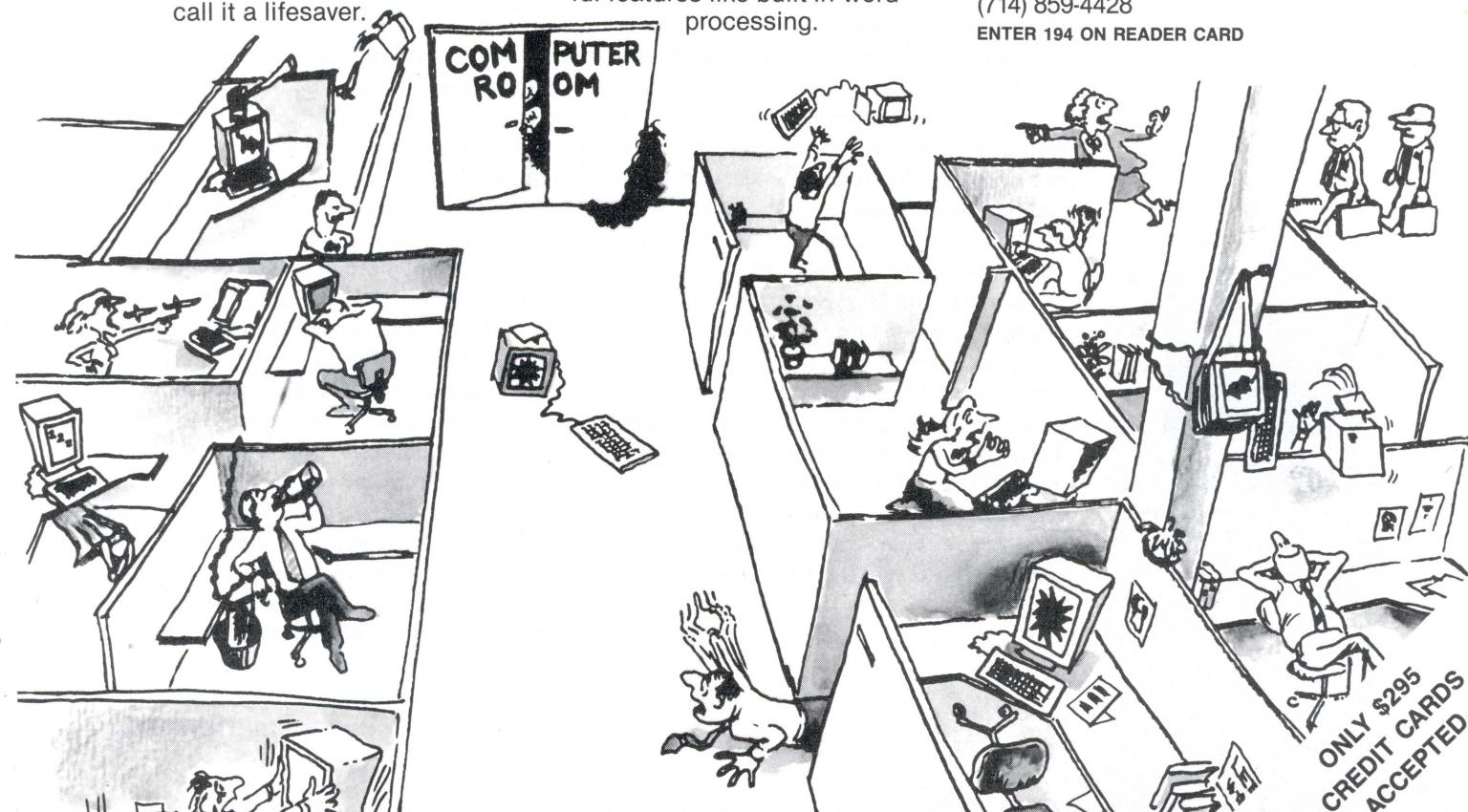
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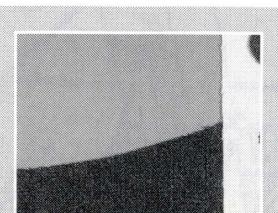
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# B EYOND CONTROL FILES

## A Method To Avoid Disk File Storage Problems



### STORAGE

Don Person

Let's consider one of the most troublesome and more mysterious parts of your computer's operating system: file storage on disc.

When a client calls waving the white flag, about half the time the cause is a disc-related failure of some kind. Of these calls, the most common difficulty is the lost or damaged data file. A pattern has emerged that bears analysis.

All too often, I find Do-It-Yourself (DIY) application designers resorting to the control file concept to store data in random access files. Because many scientific and engineering programs capture data and need to organize it on a sequential basis, storage routines are part of nearly every program written. As new information is captured or entered, you store it in the next available logical record. Individual records may have a time or date stamp and might consist of many individual numbers or strings or any combination of the two. The constant requirement is a new, unique storage location that won't overwrite existing data.

For some reason, lots of personal applications programmers, the DIYers, have hit on a common solution to this problem: You create two files. The first is a single record file containing a numeric pointer, the popular control file. The second is the main random access data file that we've just discussed. When the second (main data) file is created, you write the numeric value one into the control file.

Each time you wish to enter new records, you use the value in the control file as a pointer to the next free record in the main record file. Then we write the data and increment the pointer. The cycle concludes with a rewrite of this value into the control file on disc.

An error automatically will close the file with a write as will the WRITE VERIFY com-

mand. Viewed superficially, this is logically wonderful and guarantees protection against overwriting previous data, even if the program terminates on error. You always know which record to write to, nothing can go wrong and all is right with the world. What a nice deal.

Now look at the situation from the poor disc's point of view. Suddenly things are not so slick. If you have a 3,000-record file, by the time you've filled it, you will have forced a write to each data location at least once, but will have written the control file sector 3,000 times.

Here's the underlying problem. In general, you can read a given disc sector two orders of magnitude more often than you can safely write to it. This is traceable to two factors on floppy drives: the lack of a true flying erase head and most often, slight differences in position over the track each time the head actuator is moved. Newer 3½" units are primarily susceptible to the second of these uncertainties. Step the head back and forth and keep writing in the same place and you too could burn, figuratively speaking, a piece of the disc.

When this happens, you see the dreaded ERROR 130 : DISC message and your control file has gone up in smoke. Most people work around this when it happens by creating a new control file, and then sequentially reading through the data file to find the end. If your file is particularly large, perhaps residing on a hard disc, this may take some time and when you're all done, you're still wide open to the same problem in the future.

By now you are thinking, "There must be a better way," and indeed there is. Suppose for a moment that there was a way to quickly find the next free record in a random file, short of searching sequentially for it. A control file

*When a client calls waving the white flag, about half the time the cause is a disc-related failure of some kind.*

is no longer needed; in fact, it's irrelevant when an error closes the main file buffer. To resume, you invoke a super efficient file end-finder and continue, simply storing the current main file pointer in memory. Its volatility is no problem, because you're discovering the correct value by direct inspection each time you wish to add more records after an interrupted session.

The solution is the binary search. That this is the most elegant and efficient approach is a bonus. Look at this example: With the largest random record size allowed on Series 80 (32,767 units), never more than 15 quick reads are needed to correctly find the next data location. This number drops to just 10 for a 1,024-record file. The end result is that you write only once to each data storage location, and only perform safe read operations thereafter to position the file pointer the next time the file is reopened to add more data. After persuading others to adopt this method, neither they nor I have experienced the dread corrupt control file.

In practice, you can depend on the error reporting features of our language system. Using the binary search's divide and conquer strategy, you detect the end by successively splitting a trial pointer and testing the results of your attempt to read the selected record. If the record can be read, you know that you must make the next estimation in the higher half of the space remaining. If you receive a READING PAST END OF FILE error, you know that your guess was in the free space left.

You need to interpret some other

errors too, because the exception you trap might be caused by trying to read a string when a number is in the file or vice versa. This error needs to be handled the same as a successful read, because either way, you're looking in

the used portion of the file.

To really appreciate the speed and safety that this technique offers, you need to try it. To help you, I've coded it as an HP 86/87 function (see *Program*). The approach I'm outlining is not limited to just the 80s, however. Change the appropriate error numbers, and you can use this with Rocky Mountain BASIC, MS-BASIC, True BASIC and many other languages. Just plug in the correct error trap. —*Don Person is an independent consultant based in Albany, NY.*

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## Program I.

Note: A negative exit value is an error number.

Zero means NO RECS FREE

Any other value is the next record to write to.

rcnt is the number of random recs in the file

dumi\$ IS A GLOBAL \$\$ DEFINED "BIG ENOUGH"

file\$ is the name of the file to open and index

A normal exit leaves buffer nx assigned to file\$

Unless you use the ESTRUC binary to save and preserve error trap branches, this will leave you with no error declaration on exit. Be sure to reassert your error branch, if any.

```
DEF FNBN__SRCH (file$,nx,rcnt)      ! 'nx' open on exit
    nrec,lo=1                         ! INIT test pointer
    ON ERROR GOTO SICK                ! trap no file/disk/drive off
    ASSIGN nx TO file$                ! TRY TO OPEN FILE
    NERR: ON ERROR GOTO CANT__READ   ! INIT limits
    hi=rcnt
    CALC__SEEK: IF hi>lo THEN nrec=(hi-lo) DIV (lo+2) ELSE CHECK__IT
    READ # nx,nrec; DUMI$             ! can we read this one?
    nrec=nrec+1                       ! yes, advance one record
    READOK: lo=nrec                  ! reset low possible value
    GOTO CALC__SEEK                  ! DO BINARY SPLIT AGAIN
    CANT__READ: IF ERRN=33 OR ERRN=69 THEN READOK ! mid file ptr
    IF ERRN> 72 OR ERRN<71 THEN SICK ELSE hi=nrec
    GOTO CALC__SEEK                  ! OK, SWITCH hi VALUE
    SICK: nrec=ERRN*-1                ! SEND ERR # WITH NEG SIGN
    CHECK__IT: IF nrec>=rcnt THEN nrec=0 ! NO SPACE LEFT
    F_EXIT: OFF ERROR                 ! no crash insurance
    FNBN__SRCH=nrec                  ! this is the next free one
FN END
```



## DEVELOPMENT

Lisa Burns  
Hartman

most experienced HP 3000 programmers to groan and shake their heads. Writing a large application and making it work within the HP 3000's stack limit of 32K words can be a real challenge. In this article I'll suggest some techniques for handling large amounts of data within the constraints of the 3000's stack architecture.

When a program aborts with a STACK OVERFLOW message, it means that the 32 KW limit for stack size has been exceeded. If you're running a brand new program and you encounter this message, it means that you've simply placed too many variables on your stack at once. For a COBOL program, this means that your Working Storage is too large for the HP 3000 to handle.

But what if you're maintaining an existing application that has run successfully for some time and is now getting a STACK OVERFLOW message? There are several possible reasons this might suddenly occur. Opening additional databases or files will increase your stack size. Each additional open adds between four and 16 bytes to this area.

Another programming change that may increase stack size is a VPLUS form change adding additional fields. VPLUS itself will use additional buffer space for each added field, in addition to the necessary additional room within your program's screen buffer.

Perhaps the most likely reason for an increase in stack size, however, is a

## Alternatives For Reducing Stack Size On The HP 3000

# Help! Stack Overflow!

Stack Overflow! Those two words cause even the

new call to an additional subroutine. The linkage area necessary to communicate with the subprogram will add permanent space to the calling program.

NOW THAT YOU'VE DISCOVERED the stack overflow, you have several options, some easy to implement, some harder. The first thing to try is running your

**I**f you're running a brand new program and you encounter this message, it means that you've simply placed too many variables on your stack at once.

The local variables for the subprogram will add to the stack size as well. If the subprogram is static, this additional stack space will stay on the stack for the life of the process.

If the subprogram is dynamic, local variables will pop off the stack as soon as control is returned to the calling program.

"But," you protest, "I haven't touched the program! All I did was bring up a new MIT, and now the application blows up."

If your application was running very close to the stack limit on one MIT, and you upgrade your machine to the new MIT, this can produce a stack overflow, too. MPE intrinsic calls (file intrinsics, IMAGE calls, etc.) are frequently changed for a new MIT. Just as for your own programs, their data use may go up as well. For example, an FOPEN on UUNIT takes more space than it did on T-MIT.

Since all application programs call system intrinsics, changing a MIT can produce stack overflows in programs that ran successfully on the previous MIT.

program with the MAXDATA parameter:

```
:RUN MYPROG;MAXDATA = 20000
```

The effect of this parameter is to increase the default stack size for your program. The default stack size is set by the compiler and may be inadequate for your program. It certainly will be inadequate for your program if you're using VPLUS screens and intrinsics.

Figure 1 shows a diagram of the HP 3000 stack structure. VPLUS intrinsics place data in the DL to DB area of your stack. Compiler defaults for the DL to DB area do not allow for this needed additional space. The MAXDATA parameter, therefore, is required to expand this area for VPLUS applications. Note that the STACK parameter won't expand the DL to DB area and so will not alleviate stack problems for VPLUS users.

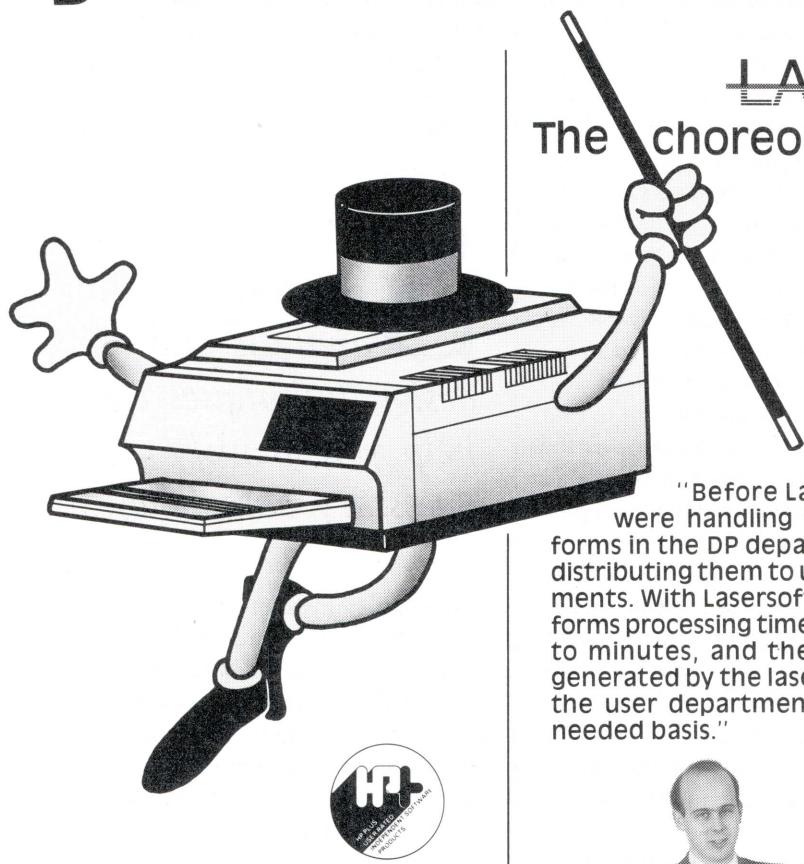
The maximum value for the MAXDATA = parameter is 32000. The real word count of this stack area is 31232, but MPE is nice enough to take 32000

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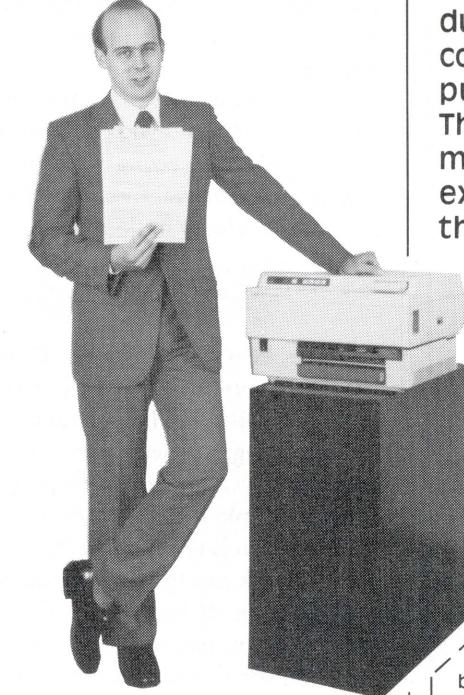
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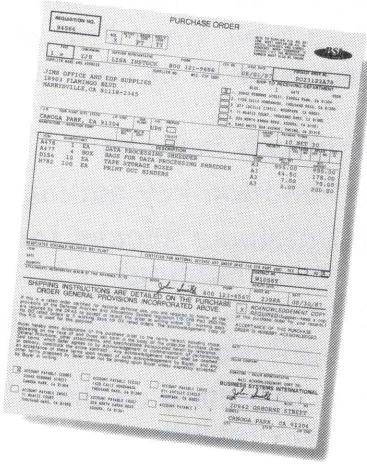
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and not make you remember that. Setting the value to the maximum will not cause harm, since the stack space will be allocated as needed in 1K increments. Thus, you may wish to go ahead and set MAXDATA to 32000.

If you'd like to be more conservative, however, and have an idea of how much stack size you really need for your application, experiment with values until you find a minimum value that still avoids the stack overflow. You can do this by beginning with MAXDATA = 32000 and working down by 5K increments, MAXDATA = 31500, and so on, until you encounter an overflow.

If you're fortunate enough to find a value of 32000 or less that removes the stack overflow, congratulations! I recommend that you re-PREP your program with this same MAXDATA option before releasing it to your users. This will set the stack size for your object code to the MAXDATA value permanently, so if your user forgets to RUN your program with the MAXDATA option, you'll still be safe. Update your PREP job to include this option, so you'll also be safe for future program updates.

But what if you already have MAXDATA set at 32K, and you're still getting an overflow? The second quick fix is to execute your program with the NOCB (no control block) option:

:RUN MYPROG;NOCB

The PCBX, or Process Control Block eXtention, is used by MPE to manage the files and file equations used by your program (see Figure 2a). This area can be very large if your program opens multiple files. The effect of the NOCB option is to move the PCBX area of your stack out to an extra data segment, freeing up more space for your application program's data area (see Figure 2b). Be aware, however, that this will mean another data segment that must be CPU-resident in order to execute your program.

If you're running on a machine that is memory-bound, running your pro-

gram with the NOCB option may increase memory thrashing and degrade your application's performance. Also, another data segment means another DST (data segment table) entry.

For MPE IV and earlier MITs, the DST is limited to 192 entries. For machines running these MITs, the

**S**tructured analysis and design techniques can help you identify necessary data flows.

NOCB option may cause the error "OUT OF DST ENTRIES". MPE V machines will not be affected by an additional DST entry, since the DST on these machines can be configured for up to 2048 entries. So, for most newer machines with adequate memory running MPE V, the NOCB option poses no threat and may be a quick solution to a sudden stack overflow.

SUPPOSE THAT YOU'VE TRIED the above two methods and are still encountering an overflow. You're going to have to work a little harder to solve your problem. The next thing to do is to look at your subprograms. Static subprograms, \$CONTROL SUBPROGRAM in COBOL, place data on the stack for the life of your process (see Figure 3). This can be a problem, especially if their data areas are large. Dynamic subprograms, \$CONTROL DYNAMIC in COBOL, free up stack space once control is returned to the calling program (see Figure 4).

There are some things to be careful of when using dynamic subprograms. Remember that since local data areas disappear once a subprogram is exited, care must be taken that any permanent

data be passed back to the calling program. Also, initialization routines will need to be executed each time a call is made to the dynamic subprogram.

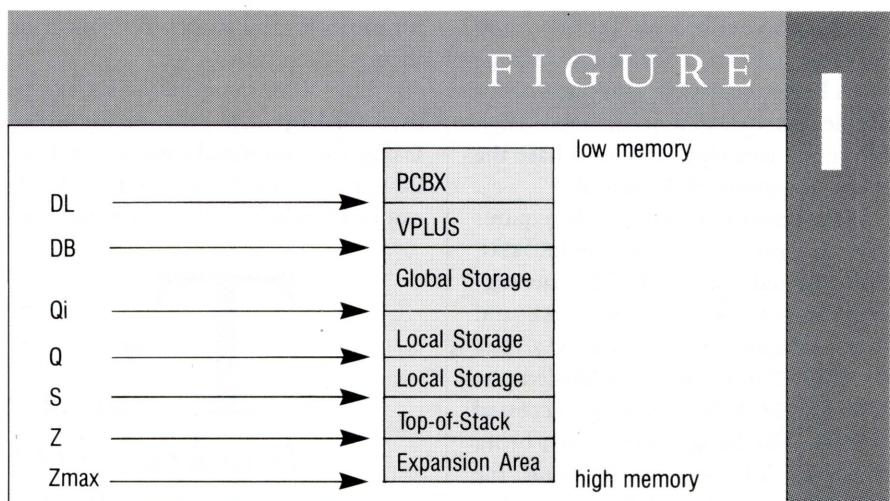
Subprograms can have another effect on stack space. What if your main program, PROG A, calls a subprogram, PROG B, which then makes its own call to a third program, PROG C? What effect will nesting these subprograms have on your process's stack? *Figure 5* illustrates the effect of this nesting. When PROG C is being executed, the data areas of all three subprograms will be resident on the stack. This is true whether or not PROG B and PROG C are dynamic. Deep nesting thus can greatly affect stack space. This is another area to examine when checking your subprograms.

Still no luck, huh? You changed your subprograms to dynamic, you eliminated excessive nesting of subprograms, and you're still aborting with a stack overflow. It's time to look at your data areas themselves.

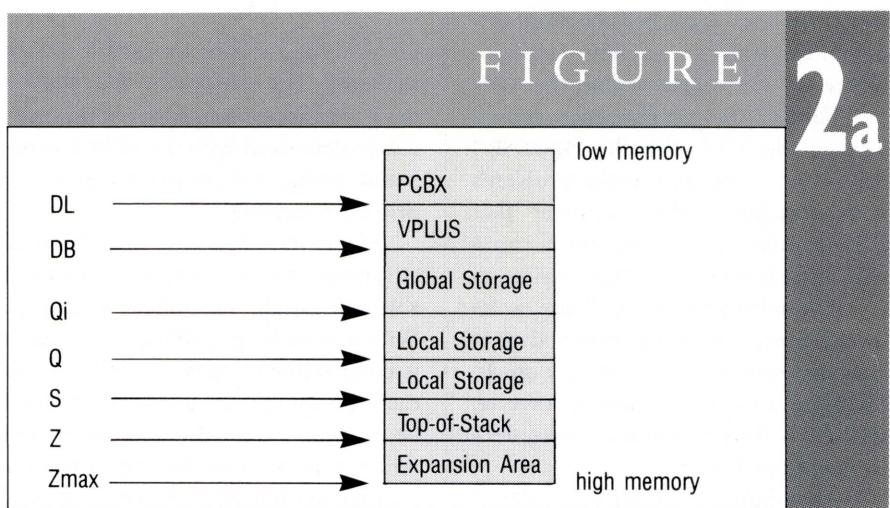
Do you duplicate data in several areas in your global data areas (working storage and linkage in COBOL)? Are you passing more data than is necessary to called subprograms? Structured analysis and design techniques can help you identify necessary data flows. Taking the time to examine what exactly is needed by a called module instead of simply passing that variable called "01 Kitchen-sink-data-area" can help reduce stack space.

Some applications are just plain big and need just plain big data areas. If you suspect that this is your situation, you're going to have to work still harder. The first thing to consider is storing needed data outside of your stack. This can be done using extra data segments or MPE temporary files. In either case, the program that needs access to the externally stored data will have to work harder than if the data were available directly.

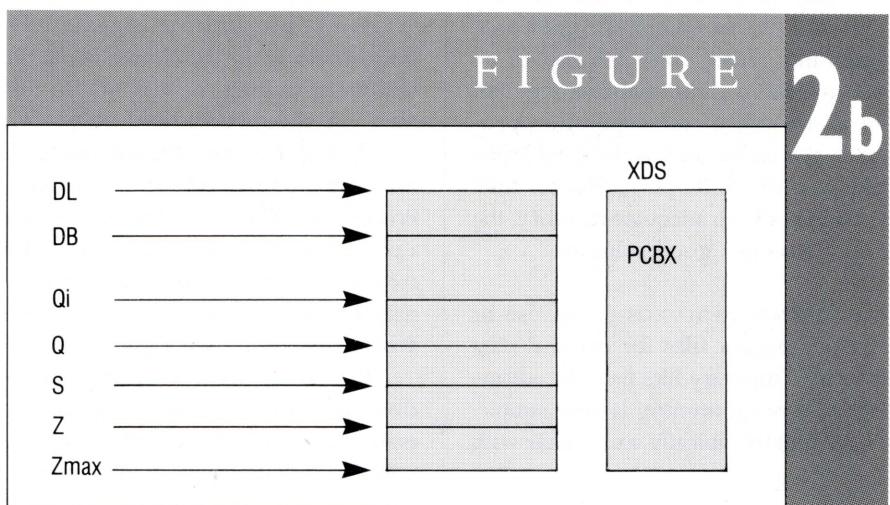
An extra data segment (XDS) is an unstructured block of memory asso-



*The HP 3000 data stack.*



*PCBX area for :RUN MYPROG.*



*RUN MYPROG; NOCB PCBX moved to an extra data segment.*

ciated with your process. It can be used for large data areas, like a report page that's being formatted all at once, or for a table structure that occurs repeatedly. Programs accessing XDS must have the special capability PH enabled.

Programming with XDS requires XDS intrinsics, GETDSEG, FREEDSEG, DMOVIN and DMOVOUT. The data segment is created with GETDSEG, and then loaded with data via the DMOVOUT intrinsic. Once loaded, the data in the XDS cannot be accessed directly. The programmer must bring the data into the stack using the DMOVIN intrinsic, and then manipulate it within the stack (see *Figure 6*). Since the DMOVIN and DMOVOUT intrinsics work with byte addresses, the programmer must keep an accurate count of where data is located within the XDS.

Finally, the programmer should destroy the XDS with the FREEDSEG command. This will avoid problems with creating a data segment that already exists if the program is run a second time from the same session.

The advantage of XDS use is its speed. Since externally stored data is memory-resident, access is very quick. There are some disadvantages, however, and one is the programming complexity mentioned above.

An additional wrinkle is that if your data area won't fit in one XDS, which has a maximum size of 32 KW, you may need to work with several. This will further complicate your programming. Also, since the use of an XDS means an additional data segment for every user of the application program, this technique has the same problems as the NOCB option. But for MPE V machines with adequate memory, the use of XDS is a good solution.

AN ALTERNATIVE TO XDS is the use of MPE temporary files for external data storage. Temporary files have the advantage that programming is very simple. Programmers typically are familiar with

file intrinsics and are comfortable using them.

Like XDS, temporary files can be used for large data areas or for tables. Using the command intrinsic and the BUILD command, the temporary file can be built within the program. Sim-

cess and then initiates its execution with the ACTIVATE intrinsic. At this point, the parent program may use the SUSPEND intrinsic to stop its own processing until the child's function is complete. When the child has completed its task, it wakes up the parent with the AC-

**T**he best way to avoid being surprised by stack overflow is to know how much stack you're using in all areas of your application.

ple reads and writes are used to access the data. The temporary file will be destroyed when the process quits, or it can be destroyed with the PURGE command within the program before the process terminates.

Temporary files have the additional advantage that they aren't limited to 32 KW and can be expanded as needed. With disk caching enabled, performance is comparable to XDS use, because the cache domain for the temporary file will be memory resident, and reads and writes will be done through memory transfer and will be very fast. However, if you can't guarantee that your program will run on a machine with caching enabled, MPE file access will affect your program's performance significantly, since accessing the data stored in the file will mean waiting for disk I/O. In this case, you should stick with XDS.

A final technique for solving stack overflow problems is Process Handling. Process Handling (PH) capability allows a process to RUN another program by creating a child process. The child process has its own stack and is independent of its parent (see *Figure 7*).

PH can be used to treat a stand-alone subroutine, a print program, for example, as a separate process. Like XDS, PH has its own set of intrinsics. The parent (calling) program uses the CREATE intrinsic to set up the child pro-

TIVATE intrinsic and then SUSPENDS itself. Finally, when the child will not be called again, the parent process destroys the child using the TERMINATE intrinsic.

PH has the advantage that the new child process gets its own stack — another 32 KW of space. There are some significant disadvantages to PH, however, the worst of which is probably the programming complexity described above. Care must be taken to synchronize the parent and child as they ACTIVATE and SUSPEND each other. If this logic is incorrect, data may be lost, or worse, both processes may be SUSPENDED at once, so nothing will happen at all!

It also should be noted that since there's noticeable performance overhead on the first call to the child, the child process should not be TERMINATED until it's clear that no further calls are needed.

Programming with PH is further complicated by the fact that since the child process is independent of its parent, it must perform its own database opens and file opens, even if the parent already has opened these files. It then will have its own file pointers and database control blocks. And since it

cannot make use of linkage areas or passed variables like a subprogram can, the child must use interprocess communication techniques such as XDS or Job Control Words (JCWs) in order to pass data back to the parent.

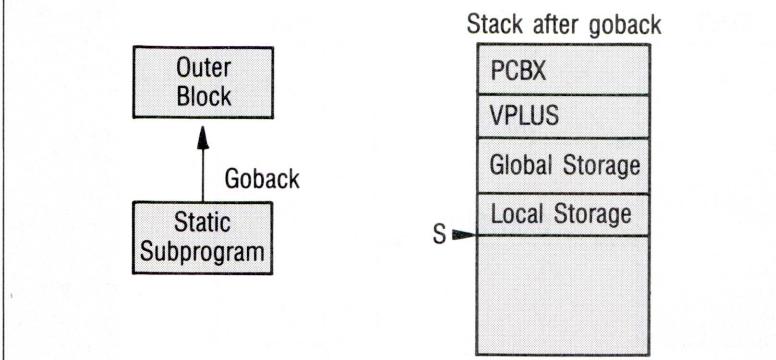
A final caution about PH is that it will double the number of processes running for a given application. This must be taken into account as far as DST use and PCB entries are concerned, especially on MPE IV and earlier MITs. Database applications also must remember that there now will be twice as many processes accessing a given database, which may affect IMAGE logging and database locking strategies.

THE BEST WAY TO AVOID being surprised by stack overflow is to know how much stack you're using in all areas of your application. The process display within the process context of OPT.PUB.SYS can show you the stack use for a given program. By running the program on one terminal and monitoring the stack use on another, you can see stack size change as you perform different functions within your program.

Figure 8 shows an example of the process display. The process shown has at one point used 27648 words of stack (SIZE). This is its "high-water" mark, the largest the stack has been. Its PCBX area is 1329 words (SYSOV). Its VPLUS area is 7640 words (DL-DB). Its main program has a data area of 10967 (DB-QI), and it has one subprogram with a data area of 3924 words (QI-Q). To determine how large its stack is at present, we need to subtract 3779 (S-Z), the space between the current stack pointer and the high-water mark, from the high-water mark, 27648 (SIZE). Thus, the current stack usage for this program is 23869.

An alternative to OPT is available for programs that don't call VPLUS intrinsics. Adding the data areas, your main program and subprograms will

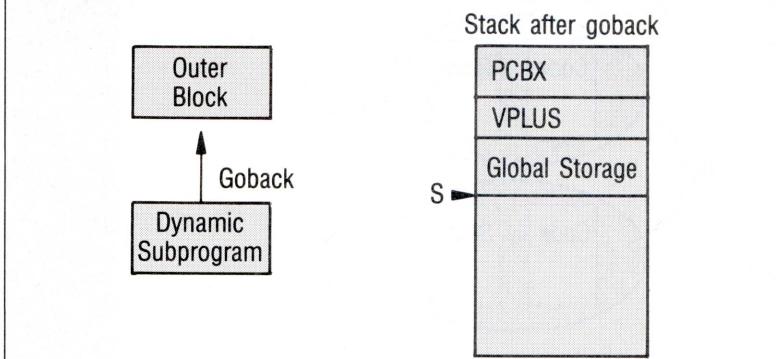
FIGURE 3



Stack space with static subprograms.

3

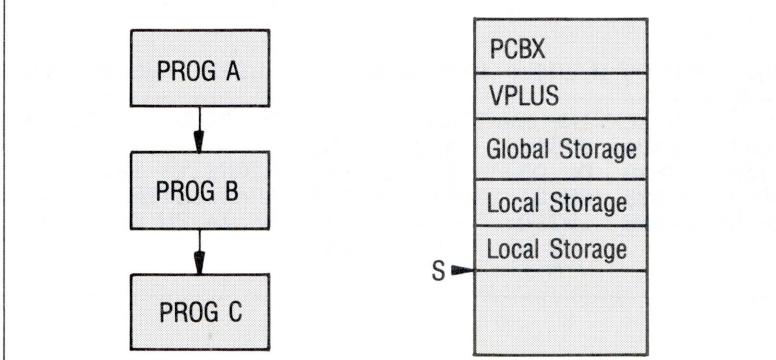
FIGURE 4



Stack space with dynamic subprograms.

4

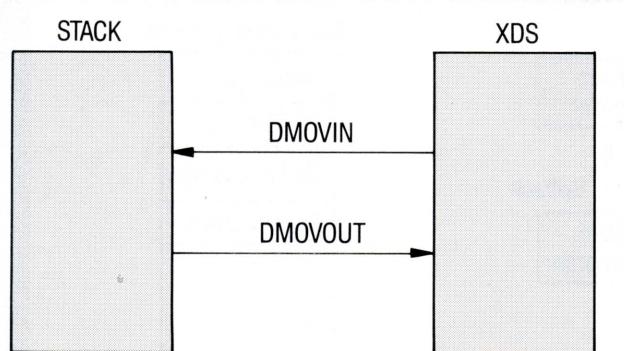
FIGURE 5



Stack space with nested subprograms.

## FIGURE

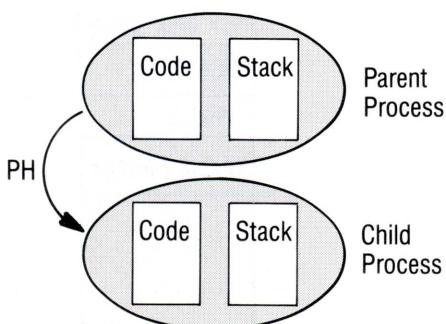
6



*Accessing data in an extra data segment.*

## FIGURE

7



*Process Handling.*

give you a close estimate of stack space. This data area is shown in octal at the end of each compile listing. Keep in mind, however, that this total will not reflect the PCBX portion of your stack.

Once you've established your current stack size, be aware of how programming changes and enhancements will affect stack use. Increases in linkage areas and global areas will add space, as will new called modules and additional file opens. These increases must be considered as you design these changes.

If you're dangerously close to the magic maximum value of 32636 (the PCBX area plus the MAXDATA area) take steps NOW to overcome the problem, not when you blow up! Consider using XDS or temporary files. Rewrite called subprograms as process handled programs. Break up one program into several if possible. Buy yourself some room for growth. You'll sleep better at night if you know that your maximum stack use is 22000, not 31999.

Of course, the real answer to stack space is to port to Spectrum, where the 32K limit will be a thing of the past. —  
*Lisa Burns Hartman manages an internal business software programming team at Hewlett-Packard corporate headquarters in Palo Alto, CA.*

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## FIGURE

8

PIN: 403 MYPROG.MYGROUP.MYACCOUNT		USER: ME.MYACCOUNT (S227) 1:12 PM	
STACK INFORMATION		CPU TIME: 7057 MSEC STATUS FLAGS:	
DST: 1403*	SYSOV: 1329 4.8%	PRIORITY: 152	MRNG GRIN LRIN
SIZE: 27648	DL-DB: 7640 27.6%	CAPABILITIES: ND SF	BIO I/O UCOP
MAXDATA: 31223	DB-QI: 10967 39.7%	BA IA PH DS	JUNK TIME MSG
MAX Z-DL: 22955	QI-Q: 3924 14.2%		
	Q-S: 9 .0%		
	S-Z: 3779 13.7%		

*Process display within Process context of OPT.PUB.SYS.*

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HP 3000

James F. Dowling

Center Management have included statements about the critical nature of batch production scheduling. Batch

**I**t's inevitable that problems will occur during off hours and that those problems will require application programming support. But the programming staff need not be required . . .

work includes any computer system operation that has been reduced to a set of well-defined processing steps stored in a catalogued procedure for execution without the necessity for a terminal operator's intervention.

In HP 3000 parlance, the catalogued batch work procedures are called Stream Files, which are executed as batch Jobs. Application system backups, Materials Requirements Planning runs, Sales Analysis and any other large or easily deferred tasks generally are relegated to batch processing.

Batch runs usually are executed after the online system users have gone home and on weekends when those users don't require access to their systems. This arrangement serves two purposes: It allows processes such as backups to gain exclusive access to the data, and it allows the total system workload to be spread across a 24-hour day rather than over the eight-hour period when most workers are on the job.

Several installations in this series on HP 3000 Data Center Management have included statements about the critical nature of batch production scheduling. Batch

The programming staff must work during the day so that constant contact with their clients can be provided, but they also must resolve any errors that occur during the nighttime processing.

At times, batch processes must be rerun during the day while the applications systems users are trying to get their work done. If the process requires exclusive access to data or if the process is extremely machine-intensive, the online users may be required to give up ac-

cess to the system until the batch jobs complete.

From the applications system user's point of view, the system is down if he can't get to his particular application and do his job. To avoid user dissatisfaction, several precautions should be taken. Figure 1 lists a menu of 10 proactive measures to help maintain high levels of user satisfaction with batch production operations. The remainder of this discussion will deal with the elements on that menu.

IT'S INEVITABLE that problems will occur during off hours and that those problems will require application programming support. But the programming staff need not be required to cover the off shift at all times. Rather, it's most often a stated goal that failures shall be eliminated in spite of Murphy's Law regarding things that fail when least convenient. Several organizational measures can be instituted that will support prompt failure recovery.

Computer operators should be trained, practiced and proficient in the use of all MPE Commands and all MPE Utilities. This prepares them for when

## FIGURE

### Batch Job Considerations

1. Organize to handle problems efficiently.
2. Design software defensively.
3. Document batch jobs.
4. Establish batch processing performance goals.
5. Schedule batch jobs.
6. Execute the schedule.
7. Review production schedule logs.
8. Adjust schedules to track actual processing.
9. Assess performance to goals.
10. Optimize the use of all resources.

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the system support personnel will instruct them (via telephone conversation) regarding how to recover from many of the common job failure causes such as file overflows, typographical errors in job stream files, incorrect runtime parameter substitutions or improperly compiled programs. Such training should include EDIT/3000, FCOPY, DBUTIL, compiler invocation, SEGMENTER and any third-party tools that commonly are used for software development or pro-

gramming avoidance.

The application system support staff should be aware of the run book documentation (see below) and the production schedule. The computer operator should be provided with an "on call" list of telephone numbers and backups for the application system support staff. If practical, the support staff should be furnished with terminals and modems to allow access to the system for immediate fixes.

By taking care to prepare both the computer operators and the application support personnel for efficient failure analysis and recovery, most problems can be resolved and rerun without the application system user even knowing that a problem has occurred. In the event that a problem does occur even if it's resolved before the user notices, the application support staff should notify the user of the problem and of the actions that have been or are being taken to resolve the problem.

A simple rule should apply to all problem resolutions: It's not fixed until the client says it's fixed. Sometimes the actions taken to resolve a problem will overlook some related process or introduce a new problem that only the client would notice. It's not totally unheard of that a set of errors will cancel each other out. In fact, I once saw a system that double-posted all debits and credits to the set of data files, yet produced perfectly acceptable control reports. It's best that the client be made aware of all failures so that he'll look for trouble early rather than discover it later.

It's vitally important that continuity of problem resolution be maintained within the application support staff rather than within the computer operation staff. The computer operator must keep the production schedule going if possible. The application support group must stay with the problem until it's resolved. This arrangement capitalizes on the skills and responsibilities of both groups to provide consistent levels of support to all system users, even when one system may be experiencing a crisis.

In summary, the organizational considerations of training, action plans, documentation, understanding roles and keeping the user aware of failure recovery activities are essential steps towards providing consistently high levels of service.

DEFENSIVE SOFTWARE DESIGN is a major topic in itself, but for the purposes of this discussion, there are two critical elements that should be addressed.

## FIGURE

2

Run Book For : SLSINVGN	Nightly Invoicing Prep & Gen	Issue : 12/31/85
Responsible Area : Sales Support		Revised : 1/15/85
Prerequisite Processes :		
Daily Shipments processing complete. SLSBKGGN Bookings run complete. SLSSHPGN Shipping run complete.		
Subsequent Processes : SLSCREDS Credit Memo extract and print SLSRPTEX Sales Reporting Extract		
Required Inputs :		
ORDMGT.ORDER.CORP Corporate order management data base (EXCLUSIVE) INVCTRL.ORDER.CORP Invoicing audit control file.		
Process Outputs :		
ORDMGT STORE format backup tape. ORDMGT.ORDER.CORP is updated by this process. INVCTRL.ORDER.CORP is re-written by this process. INVOICES.ORDER.CORP Daily Invoices file is generated. INVOICE forms are required. SL006R01 managed by Report Distribution System. SL006R02 managed by Report Distribution System. SL007R01 File in Sales System Audit Log book.		
Failure Identification :		
All known fatal error conditions are accounted for. This process will not run to :EOJ if any such errors occur. Review \$STDLIST for job failure only.		
Failure Recovery :		
Stream ORDMGTRC.JOB.CORP to :RESTORE the ORDMGT data base and the INVCTRL file to their condition prior to executing this process. Notify the "on duty" applications support person in the responsible area noted above. Hold all subsequent processing.		
Special Considerations :		
This process is classified Business Critical. This process requires exclusive access to ORDMGT.ORDER.CORP therefore no other processes requiring ORDMGT may run simultaneously.		

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# **EMC<sup>2</sup>**

The System Enhancement Company

■ It's most important that the processing environment (databases and control files) can be reset to their original condition whenever a batch process aborts or if a rerun should be required.

■ Programs and batch jobs streams should be created so that a batch job can't reach :EOJ if a recognized fatal error occurs.

The batch job (SLSINVGN) shown in *Program 1* updates the file INVCTRL and the database ORDMGT. To allow roll back to pre-execution conditions, SLSINVGN creates a "before image" STORE tape of both files as shown in the job listing. A companion job (ORDMGTRC) is shown in *Program 2*. This batch job provides the recovery

process to reinstate the "before image." By using such a paired job method, recovery is simple and direct. Note that both jobs are oversimplified, especially with respect to IMAGE logging considerations. (A future installment will deal with IMAGE database integrity management.)

When software is developed in-house, it's possible to include fatal error handling code in each program to allow the program to terminate a batch processing stream. This is accomplished by setting the Job Control Word (JCW) to a value indicating a FATAL condition. There are two ways to do this: explicitly through the :SETJCW MPE command as shown in *Program 3*, or implicitly

through the MPE QUIT Intrinsic as shown in *Program 4*.

In a shop where strict adherence to the use of QUIT or "SETJCW JCW=FATAL" is observed, the computer operator can determine job success by a simple rule: "If it reached !EOJ, it worked!" Note the second to last line in the job stream shown in *Program 1*. The :TELLOP will appear just before the MPE LOGOFF message on the operator's console. This provides a clear indication that the job completed successfully; however, the lack of such a message doesn't indicate a failure because some jobs may not provide one.

In addition to these critical elements, I've seen that most batch job reruns are caused by (I've written programs with) only a few recurring errors. These errors fall into several categories:

1. File overflows occur with all types of disc and tape files. Measures should be taken to monitor file capacities and to adjust them in advance of overflow conditions. Pay special attention to SPOOL files.
2. Disc space overflows can be avoided by employing a disc space management program. It's important to manage both disc space fragmentation and total availability.
3. Parameter substitution errors can be avoided by automating the process and by performing parameter edits within application programs.
4. Job sequence errors can be avoided by using manual checking procedures, MPE commands within job streams and best of all, by using an automated batch scheduler. See this month's "Q & A" column for some examples.

Undesirable program features (bugs) cause most reruns. I have a few favorites that I hope never to see again, such as:

- Programs that abort when there's no input data. Either no data meets the selection criteria or the input file is empty.
- Programmers that choose not to fix programs that emit the message "ILLEGAL SOURCE DIGIT IN..." until the user notices an obvious error.

## FIGURE 3

3

Schedule Name : MONDAY  
Shift : 2; 18:00 to 23:59  
- Scheduled — Actual -  
Job Name Launch Start Elapsed Start End PreReq SubSeq Job# Tapes  
SLSBKGGN Manual 18:00 00:20 \_\_\_\_\_ None SLSSHPGN #J\_\_\_\_\_  
SLSSHPGN Daisy 18:22 00:40 \_\_\_\_\_ SLSBKGGN SLSINVGN #J\_\_\_\_\_  
SLSINVGN Manual 18:44 00:35 \_\_\_\_\_ SLSSHPGN None#J\_\_\_\_\_ DT\_\_\_\_\_  
Shift : 3; 24:00 to 08:00  
PREDICTJ Sleeper 24:00 00:30 \_\_\_\_\_ None None #J\_\_\_\_\_  
TESTMEM Sleeper 00:45 00:02 \_\_\_\_\_ None None #J\_\_\_\_\_

### Notes:

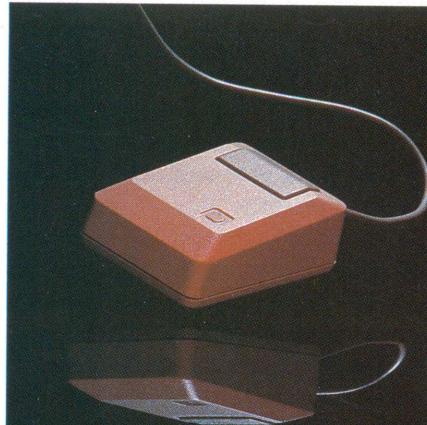
1. Launch Methods indicate how the job will be introduced into the MPE batch dispatching queue. See text.
2. Start Time is the scheduled time for job initiation.
3. Elapsed is an estimated or average run time stated in Connect Minutes as shown on the \$STDLIST.
4. Actual Start and End time are logged by the computer operator.
5. PreReq(usize) jobs must complete successfully before this job can be initiated.
6. Subsequent jobs are to be launched after this job completes successfully.
7. Job# is logged by the computer operator.
8. The presence of a Tape Number indicator notifies the computer operator that tape(s) will be required for this job.
9. Note the two-minute slack time built into the schedule. This is a safety margin that can be adjusted as appropriate.

**C**lassified as just plain weird is the family of unresolvable resource requests.

- Programs that don't compare "# Records Read" to the sum of "# Records Accepted" + "# Records Rejected."
- Programs that have "Summary" fields that are only as wide as the largest numeric in the data file resulting in an overflow sooner or later.
- Faulty break point logic (my nemesis) resulting in any or all of the following: missing first record from each page; last record on each page also at top of next; grand total not equal to sum of subtotals; last record dropped; page number one on all pages, and many more.

Classified as just plain weird is the family of unresolvable resource requests. Request three drives from one program when only one or two exists on the system. Or, there's the deadly embrace that results when ProgA requests a drive and gets Drive1, then ProgB requests a drive and gets Drive2, then ProgA requests a drive, then ProgB requests one also. Then there's a program that requests a SCRATCH tape for read access.

Both the computer operators and the application system support personnel require documentation, often referred to as "Run Books" for all batch jobs. The documentation will be used to establish a production schedule, determine failure analysis and recover processes and to communicate special instruction to the computer operators from the designers and from the clients to the computer operators. These production Run Books must be kept current and must be readily accessible to all parties concerned.



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Figure 2 depicts a typical batch production Run Book sheet for a job that creates several reporting files, updates a large database, generates several control and listing reports and creates a backup tape that can be used for failure recovery. The Run Book sheet includes:

1. The batch job name and title. A list of all batch jobs and titles should be available to the application support groups as well as the application system users. This will make discussions regarding scheduling and failures much more simple.

2. Date of issue and revision dates required for Run Book alteration control. Operators should pay particular attention to batch processes that have been changed recently.

3. The name of the application support group that's responsible for the job. This also specifies a distribution list for new issues or revisions to the run book.

4. The classification code that refers to one of four categories of criticality that might apply to the batch process. BC stands for Business Critical, DC for Department Critical, DS for Depart-

ment Support and PS for Personal Support. See *HP Professional* (May 1987) for a complete description of the classification process.

5. Prerequisite Processes listed for use by the production scheduler to avoid incomplete processing or database corruption. Several notes are in order here.

"Daily Shipments Processing Complete" can be a moving target in most environments. Fridays, quarterly endings, holidays and rush seasons can make the actual date and clock time change dramatically. Care must be taken to construct batch production schedules that consider this.

Some mechanism must be built into the batch jobs or batch job scheduler to ensure that the jobs SLSBKGGN and SLSSHPGN execute and complete successfully before this job begins execution.

6. Two processes listed as being dependent upon this process completing successfully before they can run. Scheduling controls also must be provided to ensure such.

7. A list of all required inputs including databases, permanent disc files and magnetic tapes. For each of these inputs, notations should be included if any disc file or database will be accessed exclusively by any process within the batch job.

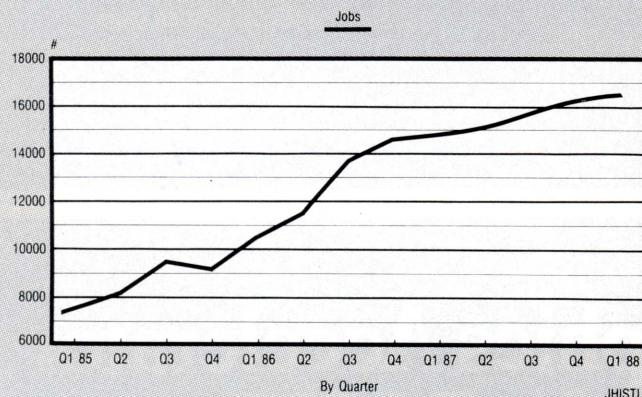
8. A list of all expected outputs including printed reports, databases, permanent disc files and magnetic tapes. For each of these outputs, instructions should be provided if computer operator handling is required or if special forms are to be used. Notations should be included if any of the disc files or databases will be accessed exclusively by any process within the batch job.

9. Preferably, all batch jobs equipped with internal controls to identify and take appropriate action should a fatal error condition be detected. A simple rule should be used: The job shall not be allowed to reach :EOJ if a fatal error is detected. In some cases, it will be

FIGURE

4

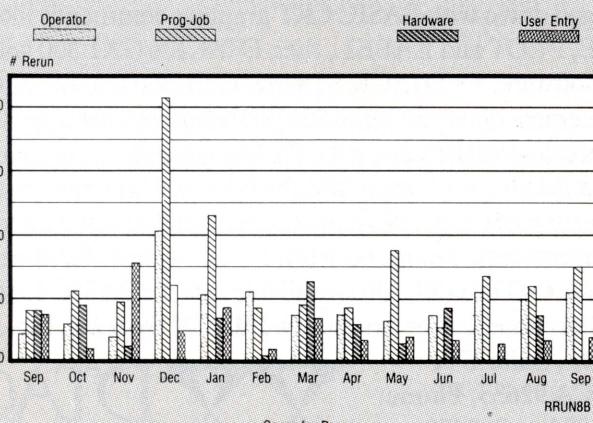
Production Jobs  
Fiscal 85, 86, 87, 88 Comparison



FIGURE

5

Job Reruns — Last 13 Months



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necessary to include instructions in the run book that will allow the computer operator to identify whether or not the job completed successfully. This should be avoided wherever possible because it's prone to error, it's time-consuming, and subsequent processes might get started or even complete before the operator locates and examines the job run listing.

10. A failure recovery procedure to get the environment (files, databases and tapes) back to a "consistent state." From the time an update job starts until it completes successfully, all data that

might be modified by the process should be considered useless or in an "inconsistent" state. Online and subsequent processing can't ensue with the database in this condition.

Even though it may require a second execution of the batch process to locate the cause of the failure, the programming group will usually be able to resolve the problem by reviewing the job process listing (\$STDLIST). If such a rerun is necessary, "debugging traces" may have to be installed into a program to help with the troubleshooting. In

either event, precious time can be saved by restoring the original environment while contacting the application support personnel.

PERFORMANCE GOALS ARE EASY to set up and evaluate. The goals must be meaningful. That is, they must apply to the

**S**everal levels of performance goals can be set for batch production processing.

business needs. The goals must be measurable quantitatively rather than subjectively if possible. And most important, the goals must be achievable most of the time.

Several levels of performance goals can be set for batch production processing. One level addresses the high-level objective of the processing: Deferring work until evening to provide better response to the online system users and producing reports that depict the state of the business as of the end of the most recent business period.

The second level of performance standards applies to the indirect contributors to client satisfaction, minimizing job reruns and managing the batch production workload.

The third level pertains to the people who are responsible for the operation and their direct contribution to the objectives: eliminating job failures and controlling costs.

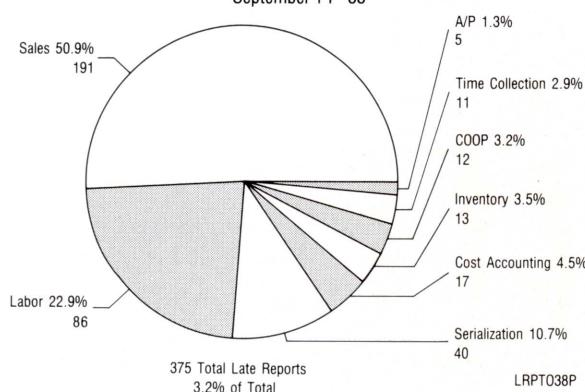
Level 1 goals might be stated as:

- Batch production complete by 08:00 Monday through Friday.
- Batch reports delivered to all user bins by 09:00 Monday through Friday.
- Less than 0.5 percent report reprints due to print quality or improper forms management.

FIGURE

6

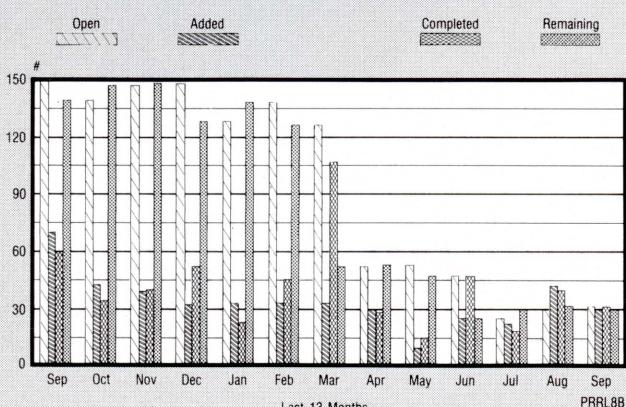
Late Reports By Area  
September FY '88



FIGURE

7

Problem Reports



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Level 2 goals might be stated as:

- Job reruns less than two percent of total per month and less than three in any one day.
- Production schedule accuracy maintained to within one hour on any day and within one half hour on any shift.
- Job runtime estimates accurate to within two minutes of the longest actual execution time in the monthly period.

Level three goals might be stated as:

- Job failures less than two percent of total

per month and less than one percent of total executions of any given job.

- Less than one percent of total printed pages left in user bins at the end of business day without user pickup.

These goals aren't directed specifically toward the computer operators or towards the programming staff. Rather, the responsibility lies with both even though the operations group might perform the measurement and re-

porting tasks.

Scheduling batch production serves many purposes, all oriented toward the successful and repeatable execution of a series of related or unrelated processes as part of the operation of business application systems. The schedule of what jobs are to run when is a plan that should be executed "as stated" so that it can be repeated.

A simple manual schedule of jobs and when to run them may suffice for a very small (20 to 30 jobs per night) batch processing schedule. The key elements are displayed in *Figure 3*. Note that magnetic tape requirements, estimated run times and launch mechanisms are included even on this manual schedule. This is done for two reasons: First, this information is quite useful when rescheduling or when additions to the schedule are necessary. Second, they provide queues to the computer operator allowing better management of his or her time.

Reviewing this schedule in detail should shed some light on many of the issues involved in the black art of batch production scheduling.

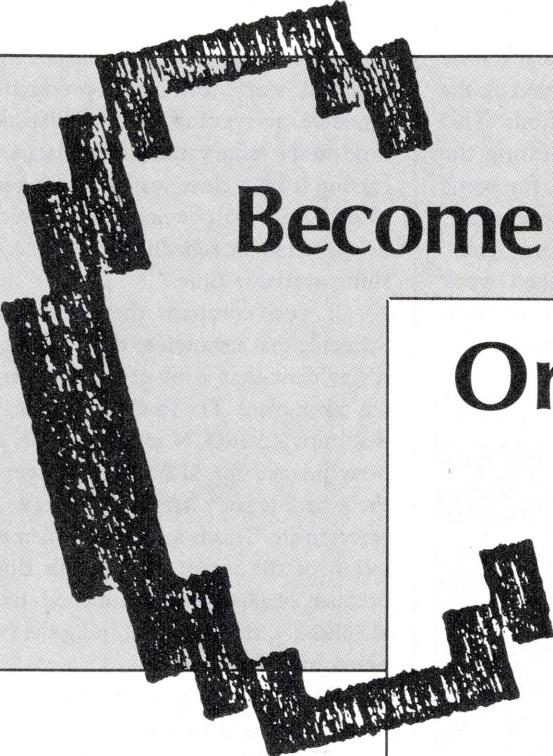
Many schedules will be required, each one created for a specific set of circumstances. Typically, one will be required for each day of the week. For large batch loads (100 or more jobs per night), individual schedules may be required for each shift of operation. In addition to this base set of schedules, many additional ones may be created to cover: Friday before month-end; Saturday of month-end; Sunday of month-end; quarterly close; physical inventory weekend and probably a special one for each holiday, snow day and Ground Hog Day. Although many of these may be variations on the base schedule, it's best to create them and keep them handy for the next time a major sequence shuffle is required.

The schedule shown in *Figure 3* has a column called "Launch." This indicates to the computer operator the origin of the job. "Manual" means that the operator is to use the MPE :STREAM

## Program I.

### The SLSINVGN Job Stream File

```
!JOB SLSINVGN,OPERATOR.CORP,ORDERS
!IF JCW = FATAL THEN
  1) Produce a "before image" STORE of the Order Management
     invoicing files.
  2) Update the INVOICED Order Flags.
  3) Extract the INVOICES that will be printed.
  4) Regenerate the INVOICE audit log.
!ENDIF
!COMMENT
!COMMENT Generate the Report Distribution List
!COMMENT
!RUN RPTDIST.PUB.UTILITY
!COMMENT
!COMMENT Create a before image tape
!CONTINUE
!FILE STORTAPE=ORDMGT,DEV=TAPE
!STORE ORDMGT@,INVCTRL;*STORTAP;SHOW=LONG
!COMMENT
!COMMENT Prepare all required files
!COMMENT
!PURGE INVCTRL0
!RENAME INVCTRL,INVCTRL0
!BUILD INVCTRL,REC=-80,8,F,ASCII,DISC=1000
!COMMENT
!PURGE INVOICE
!BUILD INVOICE,REC=-90,13,F,ASCII,DISC=10000
!COMMENT
!COMMENT Strip off the Invoices. Update the Data Base and
!COMMENT Control file.
!COMMENT
!FILE SLO07I01=INVCTRL0,OLD
!FILE SLO07001=INVCTRL,OLD
!FILE ORDMGT=ORDMGT.ORDERS.CORP
!RUN SLO07P
!COMMENT
!COMMENT Create the invoice print file and print a control
!COMMENT report.
!COMMENT
!RUN RPEQUATE.PUB.UTILITY;INFO="SLR006R01"
!RUN RPEQUATE.PUB.UTILIEY;INFO="SLR006R02"
!FILE SLO06R03=INVOICE,OLD
!RUN SLO06P
!COMMENT
!COMMENT Copy the INVOICE print file to the printer.
!COMMENT
!RUN RPEQUATE.PUB.UTILITY;INFO="INVOICES"
!FCOPY FROM=INVOICE;TO=*&INVOICES
!COMMENT
!TELLOP **** SLSINVGN Has Successfully Reached !EOJ ****
!EOJ
```



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command to launch the job. Jobs marked "Daisy" indicate that the job is "Daisy Chained" from another job either by including an MPE !STREAM command within its parent or by imbedding the job into its parent. "Sleeper" indicates the INTEREX CSL/3000 program SLEEPER will launch this job automatically at the scheduled time.

When scheduling start times for a

job, allow two minutes of slack time between jobs at first, then tighten up the schedule after several executions. This will help to avoid over-allocating the batch queue and will allow for some limited rerun flexibility in the schedule. Practically speaking, it's "End Time" that you should schedule, then work backwards to obtain "Start Time" from "Elapsed" time, since you really care

more about when the job finishes than when it starts once the production schedule gets going. Since "Elapsed" time can be quite variable with data processing load, a close watch on creeping "End Time" will be necessary to avoid delays when the schedule grows to consume available time.

If you compare the Production Schedule that's shown to the Run Book, it's evident that a bit of interpretation has taken place. The Run Book indicates that both SLSBKGGN and SLSSHPGN are prerequisites for SLSINVGN; however, the schedule only lists SLSSHPGN as its prerequisite. This is a correct implementation of the intent of the Run Book because SLSSHPGN is launched from SLSBKGGN, thereby combining the two prerequisites into one.

Daisy Chaining is a method that is commonly used for job sequences that must be strictly adhered to. It shouldn't be used to create pseudo-queues one for each of a set of applications. When used to manage queuing, it introduces a strong resistance to change, should more sophisticated scheduling methods become necessary, and it limits the ability to take advantage of all of the available CPU power. A general rule (based on experience from several conversions) is that Daisy Chaining should be avoided.

By having the computer operator enter the actual start and end times, the job number and the numbers of the tapes that were used, a built-in schedule completion mechanism is provided with the added benefit of providing for schedule management and problem resolution data.

Computer operators often will find a better way to get the jobs done. By trial and error, experience and random occurrence, performance advantages will be seen, printer use might be improved, operator idle time may be eliminated and failures might be avoided. All of these events will cause computer operators to develop their personal style of "getting the job done." Schedule ad-

## Program 2.

### The ODRMGTRC Job Stream File

```
!JOB ODRMGTRC,OPERATOR.CORP,ORDERS
!IF JCW = FATAL THEN
  1) Purge the old data base and file(s).
  2) RESTORE the files.
!ENDIF
!COMMENT
!COMMENT Generate the Report Distribution List
!COMMENT
!RUN RPTDIST.PUB.UTILITY
!COMMENT
!COMMENT Purge the old data base.
!COMMENT
!RUN DBUTIL.PUB.SYS
PURGE ORDMGT
EXIT
!COMMENT
!COMMENT Purge the file(s).
!COMMENT
!PURGE INVCTRL0
!PURGE INVCTRL
!COMMENT
!COMMENT RESTORE form the before image tape
!CONTINUE
!FILE STORTAPE=ORDMGT;DEV=TAPE
!RESTORE *STORTAP:ORDMGT0,INVCTRL;SHOW=LONG
!EOJ
```

## Program 3.

### Use of SETJCW to Terminate a Job

```
!JOB DEMOJCW,MANAGER.DEMO
!IF JCW = FATAL THEN
  If the file VITAL.PUB.DEMO is not found, this
  job will abort.
!ENDIF
!LISTF VITAL.PUB.DEMO,2
!IF JCW <> OK THEN
  ! SETJCW=FATAL
!ENDIF
!TELLOP VITAL was found ok!
!EOJ
```

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justments shouldn't be left to chance; rather, performance enhancements should be looked for and incorporated. Some suggestions:

- Jobs that tend to "run forever" when executed with other specific jobs should be set up on the schedule to run non-concurrently.
- Jobs that are found to leave tapes loaded and idle for long periods of time should be looked into and repaired.
- Jobs that are found to "blow up" when run with other specific jobs should be looked into and the one(s) that are found to require exclusive access to a resource should be so documented and scheduled.
- Jobs that produce large amounts of printed output should be placed throughout the schedule to make best use of printers and

operator time and to avoid straining the disc space resource.

- Jobs that blow up frequently should be so noted on the schedule so that special attention will be paid to them.
- Jobs that require tapes should be spread out to avoid queueing for the tape drives.
- Update jobs should be placed early in the schedule so that the more critical jobs will fail while the support people are still alert.

Allowing production processing to occur in an order other than as scheduled eventually will cause difficulty. A new operator will uncover the problem jobs or find that the "documented way" either can't be done in the allotted time or just doesn't work. For these reasons,

the schedule should be changed to reflect reality rather than be ignored for expediency. This will become blatantly obvious if one tries to convert to an automated scheduler from a manual schedule that hasn't been proven.

PERFORMANCE MANAGEMENT is a closed loop system. That is, one plans to perform an action such as to achieve a set of performance goals. The plan then is executed. The results of the action then are measured. Finally, the results are compared to the plan or goals.

The performance goals established above are all quantitative in nature, therefore simple arithmetic tells the tale. Figures 4, 5, 6, and 7 are copies of slides that are used at Bose Corporation each month to report activities and to evaluate attainment of service levels. Similar charts and reports can be developed to address any particular environment and management situation.

In practice, the data that's reported each period changes depending on where the current problem has settled in. I suggest that you use the charts to show progress towards a goal and that text be used to state that the goal is being achieved. Flat lines are boring and indicate complacency. Do not, however, strive for the limit; rather, maintain good performance in all areas, then pick one for improvement. Once that has been achieved, tighten the reigns on another.

As stated in earlier installments, we're trying to manage the performance levels of all of the data processing resources that may be at our disposal. We can trade inexpensive resources for expensive ones or those that are in plentiful supply for scarce ones in our efforts to optimize the effectiveness of the batch production operation.

Experience shows that reducing dependence upon people resources yields the best long-term advantage. Provide faster machines, faster tape drives, faster printers, automated production schedulers, tape library systems,

## Program 4.

Invocation of the QUIT Intrinsic  
With the Value of PARAM Set to 6.

```
RUN QEDIT.PUB.ROBELLE
QEDIT. Copyright Robelle Consulting Ltd. 1977,1986
/:RUN QUIT.PUB
ABORT :QUIT.PUB.VOLZ.%0.%1
PROGRAM ERROR #18 :PROCESS QUIT .PARAM = 6
PROGRAM TERMINATED IN AN ERROR STATE. (CIERR 976)
```

End Run

Note that QUIT.PUB aborted by QEDIT (its Father) did not.

```
/:SHOWJCW
JCW = FATAL6
CIERROR = 976
```

Invocation of the QUITPROG Intrinsic  
With the Value of PARAM set to 6.

```
/:RUN QUITPROG.PUB
ABORT :QUITPROG.PUB.VOLZ.%0.%1
ABORT :QEDIT.PUB.ROBELLE.%3.%13114
PROGRAM ERROR #19 :PROGRAM ERROR #21
:PROGRAM QUITPROGRAM KILLED
.PARAM = 6
PROGRAM ABORTED PER USER REQUEST. (CIERR 989)
```

This time both QUITPROGRAM.PUB and QEDIT were killed.

```
:SHOWJCW
JCW = SYSTEM0
CIERROR = 989
```

report management systems and training before adding computer operators or shifts of operation.

Equip the support staff with terminals, modems and documentation so that travel time and inconvenience during off hours is minimized. To support the programming staff, provide training to the computer operators.

Challenge the work load using the "hogs" rule. Challenge the need for all copies of the largest report until all reports greater than 50 pages for all copies have been reviewed. Challenge the need for and/or design of the longest running batch jobs until all jobs that run more than 30 minutes have been reviewed. Challenge all reports that are printed on special forms or that use non-standard carriage control.

In effect, I like to think of the batch operation as a cookie factory that produces cookies in the form of 15-minute batch jobs that produce 10 pages of output each. Only one out of 50 jobs requires a magnetic tape and none require more than one drive at a time. All of these processes can run simultaneously and in any order.

Anything that doesn't look like one of these cookies is considered to be a special case requiring excessive resources. These special cases (most all batch jobs in the real world) should be reviewed periodically to justify their excessive use of system resources. Whenever possible the needs should be removed, but not at the expense of another resource unless careful consideration of the long term effects is given.

IN THE SYSTEM LIFE CYCLE for most applications, batch production processing, associated tape and print handling accounts for most of the human work that occurs in the Management Information Systems groups. This aspect of application support takes place out of site and after hours. Consequently, it doesn't usually obtain sufficient recognition as one of the most critical activities that contribute toward user satisfaction and department harmony.

Preparation, management and continuous attention paid to batch production will have a profound effect on both User-MIS and Development-Operations relationships. In the next installment in this series, I'll introduce a concept that I refer to as Critical Path Batch Production Scheduling as a means of

assuring that business needs are met.  
—James F. Dowling is manager of Computer Services for Bose Corporation, Framingham, MA, and technical director of Volz Associates, Inc., Winthrop, MA.

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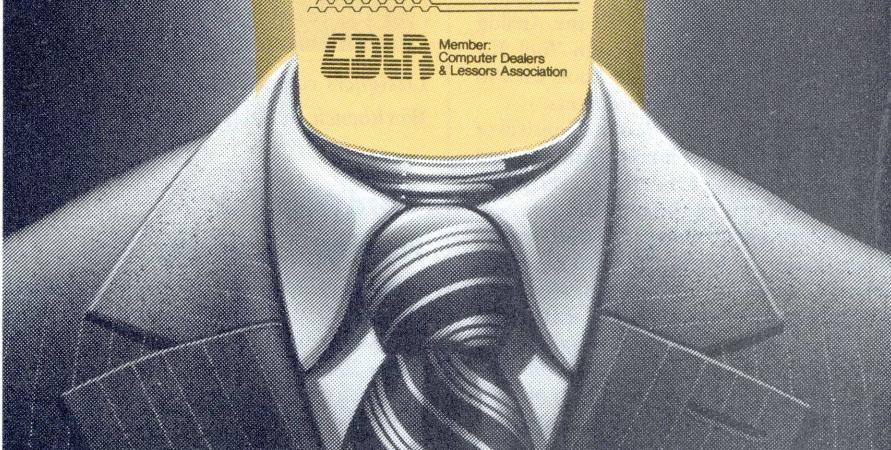
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Continued from page 25.

ing physical memory is used by XL/3000. The total amount of physical memory can be beyond what MPE is capable of recognizing.

Kelly has taken advantage of its technical leadership in the design and manufacture of memory boards for the HP 3000 to design a product that can improve both run times and response times of certain applications by as much as 50 percent. XL/3000 also reduces the number of CPU seconds by up to 25 percent due to a reduction in the requirement for MPE to manage overhead processes.

The product looks like a disk drive to the system, complete with DRT and LDEV numbers. XL/3000 provides a number of advantages over hard disk and disk caching: Reads and writes are instantaneous and disk caching only has the current "working set" of data in memory.

The Kelly XL/3000 RAMDISC gives the user more control of the system to maximize performance and actually reclaim system resources.

Contact Kelly Computer Systems, 1101 San Antonio Rd., Suite 419, Mountain View, CA 94043; (415) 960-1010; Telex: 4931648 KELLY UI.

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## New Design Tools For Analog Workbench

Analog Design Tools has announced a special set of design tools for the Analog Workbench focused on the needs of analog circuit designers working on printed-circuit-based, discrete-device systems like those found in telecommunications, radio, automotive and industrial control designs.

Used in conjunction with the Analog Workbench, the Circuit Design Tool Kit contains a full set of the CAE tools used to design and analyze discrete circuits.

The Circuit Design Tool kit consists of the General Device Library, Statistics and Parametric Plotting Modules. It also incorporates major new enhancements. Users now can analyze group delay, a useful feature when designing filters. They also can select tolerance distribution functions (Gaussian, flat, skew, bimodal and custom) for statistical analysis calculations. New additions to the model libraries include SCRs, two- and four-diode bridges, a more sophisticated op amp model and state-average power controller models for faster simulation.

The Circuit Design Module is available as an independent option running on all versions of the Analog Workbench, including

those configured for engineering workstations from HP, Sun Microsystems and Apollo Computer. It also is available as an option on the PC Workbench, the IBM PC/AT-based version of the Analog Workbench.

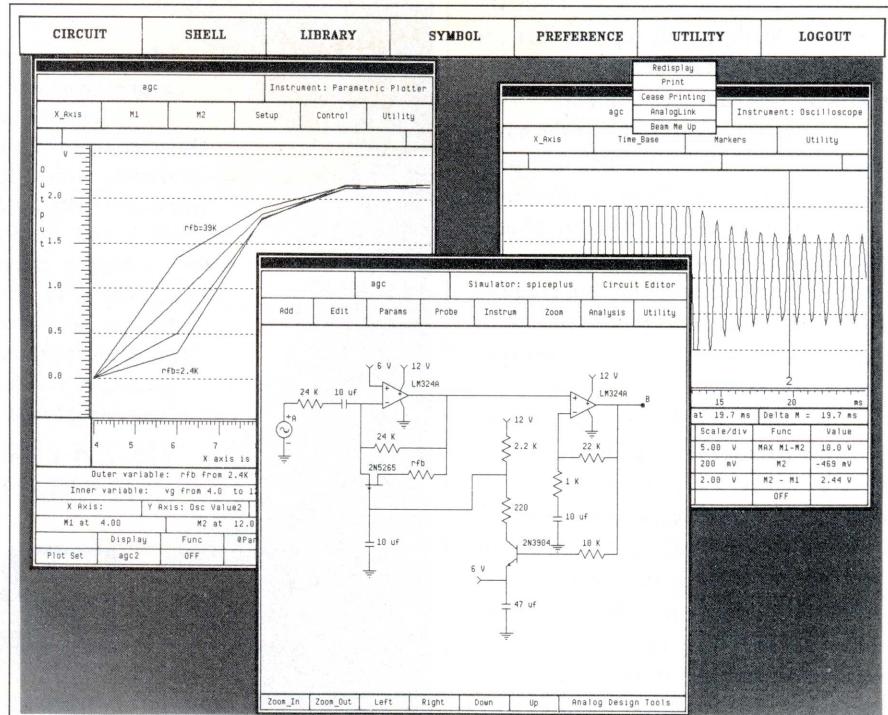
As an option to the Analog Workbench, the price of the Circuit Design Tool Kit is \$17,000 per kit for the PC Workbench version and \$31,500 for the Analog Workbench version.

Contact Analog Design Tools, Inc., 1080 E. Arques Ave., Sunnyvale, CA 94086; (408) 737-7300 or (800) ANALOG-4.

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choose between an American English spell-checking dictionary, or one in a European language such as French, German or Spanish. The WordWise special character set also has been revised to make it easier to word process using foreign accented vowels. All other features of WordWise 300F are the same as those of WordWise 300, including a mailing list database, a built-in terminal emulator, support of Greek and math characters, endnotes, indexing, a table of contents generator and full support for SRM users.

WordWise 300 graphics features have been improved, now allowing users to print HPGL graphics files right along with text.



*Designers can use Analog Design Tools' Circuit Design Tool Kit with the Analog Workbench to design and analyze discrete circuits.*

## WordWise For Foreign Languages

James Associates is now shipping version 300.2 of WordWise, the newest update of the company's word processor for HP 9000 Series 200/300/520 computers. In conjunction with this release, James Associates is introducing WordWise 300F, a new version of the software that's tailored for users of European languages such as German, French and Spanish.

WordWise 300F (\$495) allows users to

The graphics feature introduced in WordWise 300.1, which allows users to cut graphics from another BASIC application and insert those graphics into WordWise text files, is still part of the software package. WordWise 300 spell-checking has been modified to check for proper capitalization.

Current WordWise users can receive updates at a reduced price.

Contact James Associates, 1525 East County Rd. 58, Ft. Collins, CO 80524; (303) 484-5296.

**Enter 910 on reader card**

## HCC Announces DBsize for HP 3000

Hawthorne Computer Center (HCC) announced the release of DBsize, a dataset capacity maintenance tool designed for nontechnical users of turnkey HP 3000 systems.

DBsize can be run in an "automatic" mode which requires only that the user answer a few yes/no questions and enter the database name. The user may even enter an "@" as the database name to cause DBsize to process all databases in the logon group.

DBsize (\$495) examines each dataset in the database, looking for those where the entry-count exceeds a specific percentage of the capacity. When such a dataset is found, its capacity is increased to a new value which is determined by an algorithm developed by HCC. If the dataset being enlarged is a detail, all associated masters are automatically examined to ensure that they can accommodate the detail's new capacity and also are enlarged if necessary.

In the "manual" mode of operation, DBsize can be instructed to modify the capacity of any individual dataset regardless of the current entry-count as long as the new capacity won't result in any loss of data.

DBsize will operate on any HP 3000 system using MPE-IV or MPE-V with IMAGE or TurboIMAGE.

Contact Hawthorne Computer Center, 3454 S.E. Powell Blvd., Portland, OR 97202; (503) 239-4778.

**Enter 906 on reader card**

## Software Makes American Debut

TC Informatica has introduced its latest security programs in DOS to the American market: Libra and SpaceBuster.

Libra is a software protection program that prevents the unauthorized duplication of programs on either 5 1/4-inch or 3 1/2-inch floppy disks. It doesn't require specially treated disks, linking of object modules and is compatible with other protection systems. Libra protects your program in two ways: diskette protection and file protection.

SpaceBuster encrypts and compresses COM and EXE files into shorter files recognizable by DOS that contain safeguards against the use of debuggers. The new compressed program automatically will return to its expanded form in memory at the time of execution.

Libra and SpaceBuster are produced by the technical staff of TC Informatica's Rome

office. Both programs work with any DOS-compatible software and on personal computers.

Contact TC Informatica Corp., 420 Lexington Ave., Suite 2817, New York, NY 10170; (212) 972-5057.

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## Breakthrough Enhances Time Line Graphics

Breakthrough Software, a division of Symantec Corporation, has announced Time Line Graphics version 1.1. The new version (\$195) supports HP and other popular laserjet and dot-matrix printers and an even larger list of plotters than did Time Line Graphics version 1.0.

Time Line Graphics is an add-on program to Time Line project management software for the IBM PC. Graphs in three formats are produced: Time-scaled PERT, standard Gantt and Actual-vs-Plan Gantt.

Time Line Graphics 1.1 is available in either 5 1/4-inch or 3 1/2-inch diskettes. All current registered users of Time Line Graphics 1.0 will be sent a free upgrade. Contact Breakthrough Software, 505-B San Marin Dr., Novato, CA 94945-1310; (415) 898-1919.

**Enter 909 on reader card**

## New PC-Based Typesetting Software

G.O. Graphics, Inc., a supplier of PC-based typesetting software, has announced Multi-User Deskset Design Edition. The product is compatible with Novell NetWare and a variety of other network configurations such as Network-OS from CBIS, Inc.

Depending on the network software, Multi-User Deskset can support shared files, shared output devices, file locking, laser printer and typesetter output spooling and foreground/background operations utilizing the Deskset Device Server. The product includes support for a network with three workstations and can accommodate up to 99 workstations with multiple file servers, typesetters and laser printers.

The Deskset Device Server enables workstations to queue files very quickly so that the workstation isn't tied up while files are output to the laser printer or typesetter. Low-cost workstations without hard disks can be used because files are accessed from the file server hard disk. The Deskset Typesetter Interface is installed in the Device Server along with a JLaser Plus for connection to a laser printer with a Canon CX or

SX engine such as the Hewlett-Packard LaserJet. Workstations receive feedback messages regarding the status of the typesetter. The configuration also permits increased system security, improved file organization and electronic mail between workstations.

The list price of Multi-User Deskset Design Edition is \$5,495, which supports three workstations. Each additional workstation is \$995.

Contact G.O. Graphics, 18 Ray Ave., Burlington, MA 01803; (800) 237-5588, (617) 229-8900 in MA.

**Enter 912 on reader card**

## Interscience Announces 1000 LPM Band Printer

Interscience, a supplier of peripheral subsystems, has announced a new band printer, 1000 LPM, that is fully plug compatible with HP 3000 systems.

The printer (\$12,165) is manufactured by Dataproducts and uses an Interscience proprietary interface. It works at high-duty cycles with minimal maintenance, using Dataproducts Mark V hammerbanks. It features a combination of the friction-free hammerbank and a laterally moving full font steel band.

More standard features include a built-in diagnostic display, long-life ribbon cartridges and a floor-length acoustical cabinet. Contact Dianne Miller at Interscience Computer Services, Inc., 5171 Clarendon Drive, Agoura Hills, CA 91301; (800) 622-2077 or (818) 707-2000 in CA.

**Enter 915 on reader card**

## Solution Designed For Plastics Companies

MDSS/Plastics, a software solution specifically designed for companies that make plastic parts or build plastic products, recently was announced by Manufacturing Decision Support Systems, Inc. (MDSS).

MDSS/Plastics allows manufacturers to plan and control all types of manufacturing environments, including injection, compression and blow molders; profile and sheet extruders; blown film producers; and other types of plastic operations.

This new package includes Estimating and Quoting, Custom Order Management, Material Management, Labor Management, Financial Control, Security and Training System, and 4GL Report Writer.

Contact MDSS, 300 East Ohio Building, 1717 East 9th St., Cleveland, OH 44114; (216) 861-8100.

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## BBS-PRISM Offers Full-Screen Editing

Bradford Business Systems, Inc., has released BBS-PRISM, a full-screen editing subsystem for the HP Vectra, HP-150, IBM-PC and PC clones. The package offers full-screen editing, compiles from within the editor including support for most compilers on all supported machines, a word processing environment, left and right scrolling, a built-in calculator, the ability to run other programs and perform DOS and MPE functions from within the editor and more.

The package was based on SPEEDEDIT, which is designed for HP 3000 users, but PRISM has been entirely rewritten so that it could be ported to the PCs as well as other systems in the future.

The BBS-PRISM system (\$295) has language-sensitive contexts for structured languages such as PASCAL, C, and HP's SPL as well as text and word processing environments.

Contact Bradford Business Systems, Inc., 25301 Cabot Rd., Suite 201, Laguna Hills, CA 92653; (714) 859-4428.

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## Pantechnic Improves LaserJet Support

Pantechnic has made significant new enhancements to its Textpro word processing system. These changes are contained in the latest release, version 11.00.00.

Support for the HP LaserJet printer has been simplified so that a single command provides access to all fonts on a cartridge. Textpro's functions also have been expanded to include proportional text printing and automated use of dual bins and provision for 8-bit character sets and the extended Roman character set. Finally, new entry points for the support of Spectrum have been implemented.

Textpro (\$4,000) is available for the HP 3000. It includes full-screen block mode editing, complete access to IMAGE databases, a 100,000-word spelling dictionary and the capability to edit program source code. Contact Pantechnic, Inc., 89 Mountain Valley, Oakland, CA 94605; (415) 451-2381.

**Enter 913 on reader card**

## New Software Links HP 1000, LXE Data Terminals

Comsci Data Systems Inc. has announced the LXE Handler/1000, a software package that allows HP 1000 minicomputers to interface

with LXE's hand-held wireless data terminals.

The LXE Handler/1000 allows LXE wireless data terminals to access an HP 1000 in real-time through LXE 120 computer interface units (CIUs). The software package, developed by Comsci Data Systems, provides network initiation, diagnostic logging and diagnostic reporting. The LXE Handler/1000 will run on an HP 1000 using RTE-6VM, with CI support and RTE-A through REV 4.1.

The software is targeted at production, distribution and warehousing environments where real-time record updates can provide management with greater control, thus reducing inventory and costs.

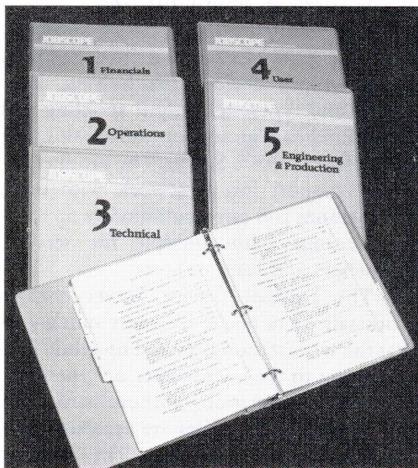
The LXE Handler/1000 software communicates in full-duplex on one or two multiplexer ports, handling all communications between the HP 1000 and LXE 120 CIU. One multiplexer port is required for each CIU. Two ports can be used for separate input and output ports.

The LXE Handler/1000 software, including one-year product support, media option (CS-80 or 1600 bpi), and user manual, is available for \$5,500. A "right to copy" license on one additional computer is available for \$1,100. One year of software product support is available for \$550. Contact Comsci Data Systems Inc., P.O. Box 20101, Atlanta, GA 30325; (404) 352-3533.

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## JOBSCOPE V.7 Ensures Efficient Manufacturing

The Jobscope Corporation, a subsidiary of the Gower Corporation, announces the



*JOBSCOPE V.7 provides hands-on planning.*

release of JOBSOPE Version 7. The software standard for the order-driven business, JOBSOPE is designed to meet the informational requirements of large project-oriented manufacturers and service companies.

Sold and distributed by HP, JOBSOPE provides hands-on control of job planning, scheduling and costing functions for companies that manufacture made-to-order products or provide services on a contract basis.

JOBSOPE is a fully integrated manufacturing and financial system that ensures accurate estimates and work scheduling, efficient manufacturing, and delivery of services. It permits constant cost updates and materials tracking from initial bidding to final delivery.

Contact Jobscope Corporation, 555 N. Pleasantburg Dr., Suite 214, Greenville, SC 29607; (803) 233-1853.

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## Trivector Adds True Fonts To 3-D CAI

Trivector Incorporated, producer of the three-dimensional computer-aided illustration (CAI) system, announces the addition of true fonts to its illustrator product.

The font software, licensed from Gradco Systems, Inc., in association with Composition Technology International, produces high-quality fonts without stored bit-maps. The company says text and graphics can be produced up to 30 percent faster than conventional bit-mapped characters. This new technique also reduces disk space storage requirements by up to 70 percent. In addition, it has no limits on the number of font styles or sizes it can generate.

The Trivector system incorporates a unique patented dual cursor which simplifies and speeds up creation of a 3-D model from which all illustrations are produced by requesting desired vantage points.

The Trivector 3-D CAI system is available as a turnkey bundled system and an unbundled software kit.

Hardware platforms supported include Hewlett-Packard, Apollo, IBM PC/AT, Sun Microsystems and VAXstation 2000 & GPX.

Software interfaces supported include IGES 2.0 & 3.0, Calcomp 925/960, HPGL, Compugraphic CAPS, Interleaf, Kodak Keeps, Omnipage, Talaris Systems, Texet and Xyvision.

Contact Trivector, Inc., 5411 Avenida Encinas, Carlsbad, CA 92008; (619) 438-8842.

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## VenturCom Announces

### VENIX System V 2.3

VenturCom, Inc. has announced VENIX System V Release 2.3, a real-time UNIX operating system for PCs. VenturCom services commercial users such as General Electric, and major system integrators like Electronic Data Systems and AT&T.

VENIX 2.3, a licensed UNIX System V, features performance enhancements, real-time extensions, adherence to AT&T standards, support for the IBM Enhanced Graphics Adaptor (EGA) board, AT&T binary compatibility, developer tools including a Large Model C Compiler, and Ethernet TCP/IP network support. It's available for IBM PC AT and compatibles, the HP Vectra Plus and the Compaq DESKPRO 386.

Applications that run on VENIX 2.3 include Unify and Informix database packages, the Q-calc spreadsheet, Preclude Office Information System and others. VENIX 2.3 supports AT&T Intel 80286 executable

binaries (Common Object File Format) so programs written for the AT&T 6300 Plus will run on VENIX without recompiles.

Performance enhancements include improved memory management to minimize I/O, a more efficiently coded kernel, a larger 1024-byte file system and an extended buffer cache.

The full VENIX 2.3 system is priced at \$990 for single quantity purchases, but is being offered at an introductory price of \$600 for a two-user system until December 31, 1987 (limit one copy per customer). It comes with an indexed, four-volume set of documentation.

Contact VenturCom Inc., 215 First St., Cambridge, MA 02142; (617) 661-1230.

**Enter 918 on reader card**

## Rapitech Introduces FORTRIX-Ada

Rapitech Systems, Inc. has expanded its line of Conversionware packages by adding a Fortran-to-Ada translator. FORTRIX-Ada,

as the Conversionware program will be known, automatically converts programs written in FORTRAN to Ada, the programming language mandated by the Department of Defense for embedded systems and mission critical software.

To accomplish this, Rapitech has signed an exclusive worldwide marketing agreement with Science Applications International Corporation (SAIC) to market SAIC's FORTRAN-to-Ada translator.

Rapitech developed and currently markets FORTRIX-C, which converts FORTRAN to C. The automatic Conversionware program converts 50,000 lines of code in under two weeks, a process that would take two man-years if done manually. Later this year, Rapitech will introduce COBLIX-C, another Conversionware product, which converts COBOL to C.

Contact Rapitech Systems Inc., Montebello Corporate Park, Suffern, NY 10901; (914) 368-3000; (800) FORTRIX; Telex 509210; Fax 368-3082.

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## Utah COBOL Enhanced

A new edition of Utah COBOL has been released by Ellis Computing. Utah COBOL version 4.0 (\$69.95) has been enhanced to include: multikey indexed files with up to 24 keys, fast memory mapped video displays, level 88s, ACCEPTS numeric data with decimal point alignment, numeric checking, cursor positioning, color, auto-skip and more.

One of the design features of the new compiler is the way the indexed file support is integrated with Btrieve (a registered trademark of Softcraft, Inc.). The COBOL programmer writes standard ANSI-74 indexed file statements, just like on a mainframe; but at runtime the program automatically interfaces to the independent package Btrieve. This approach allows other languages, such as FORTRAN, PASCAL or BASIC to access the COBOL's database. Contact Ellis Computing, Inc., Software Technology, 5655 Riggins Court, Suite 10, Reno, NV 89502; (702) 827-3030.

**Enter 917 on reader card**

## New Lexi Printers Embrace Prescribe

LEXI Computer System Corp.'s two new laser printers for the COAX A marketplace, the 2087 and 3087, feature Prescribe, a ver-

satile page description language capable of integrating text with charts, boxes and circles. Prescribe is faster than competitive page description languages because it requires less memory to generate graphics.

Prescribe allows users to customize documents using, for instance, only 35 simple English characters to construct the 7-inch by 9-inch box when competitive systems require a set of 237 English characters and escape sequences, which reduces overall performance of the computer system. Prescribe also features forms overlay and signature scanning capabilities.

The 2087 10 page-per-minute (PPM) unit (\$6,995) and the 18 PPM 3087 model (\$10,995), based on the Kyocera electrophotographic laser printer engines, allow users to select from a resident library of 38 fonts in the 2087 and 78 fonts in the 3087.

The LEXI 2087 and 3087 emulate the IBM 3287, 4214-2, 3268 and operate in the LU1, SNA and LU3 non-SNA environments. Both laser printers attach directly to IBM 3174, 3274 and 3276 controllers. The laser printer models have switchable RS-232 interfaces, which allow optional connection to personal computers. When connected in this environment, the LEXI printers emulate Hewlett-Packard LaserJet and five other emulations.

Contact LEXI Computer Systems Corp., 231 Sutton St., Suite 1D, North Andover, MA 01845; (617) 681-1118.

**Enter 920 on reader card**

## Black Box Offers 3396 WP Workstation

The Black Box 3396 Word Processing Workstation emulates IBM 5219 printer functions and was designed for users of IBM Displaywrite/36 and Text Management programs. It enables continued use of existing printers while providing 5219 capabilities.

Any printer with either HP or Diablo 630 capabilities that's attached to the 3396WP will emulate the IBM 5219 word processing printer. Quality printouts are generated on the printer by activating either the Displaywrite/36 or Text Management codes.

The 3396 WP (\$1,995) also doubles as a printer interface, allowing many laser, matrix or daisy-wheel printers to be attached to its RS-232 serial port. It provides system addressability; any terminal on the system can send documents to the attached printer without tying up the 3396 WP's terminal portion.

Contact Black Box Corporation, P.O. Box 12800, Pittsburgh, PA 15241; (412) 746-5530.

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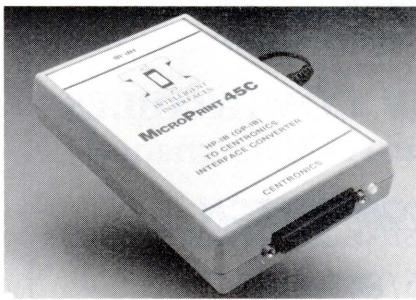
## FLEXIBASE Enhanced

Proactive Systems has released a major new version of its FLEXIBASE package, an IMAGE database management utility. The following enhancements are incorporated:

1. Database performance and diagnostic module for the analysis of operational databases. For example, it will provide information on the number of secondaries in master sets, how "messy" detail sets are, average chain lengths, etc. It will automatically recommend reblocking, repacking or capacity changes where appropriate.
2. A new capacity change module that is quicker and easier to use. Changes can be specified in terms of required capacity or percentage change up or down. Master sets can be automatically rounded to the nearest prime number for optimal hashing.
3. Database transformations (i.e., structural changes, new items, new sets, renaming, etc.) now can be set up and run in batch against several databases while retaining the old capacities of the databases in all cases. This will be useful to organizations that support systems on more than one HP 3000 and need to replicate changes to more than one copy of a database.
4. A significant improvement in performance of FLEXIBASE in all aspects of the pro-

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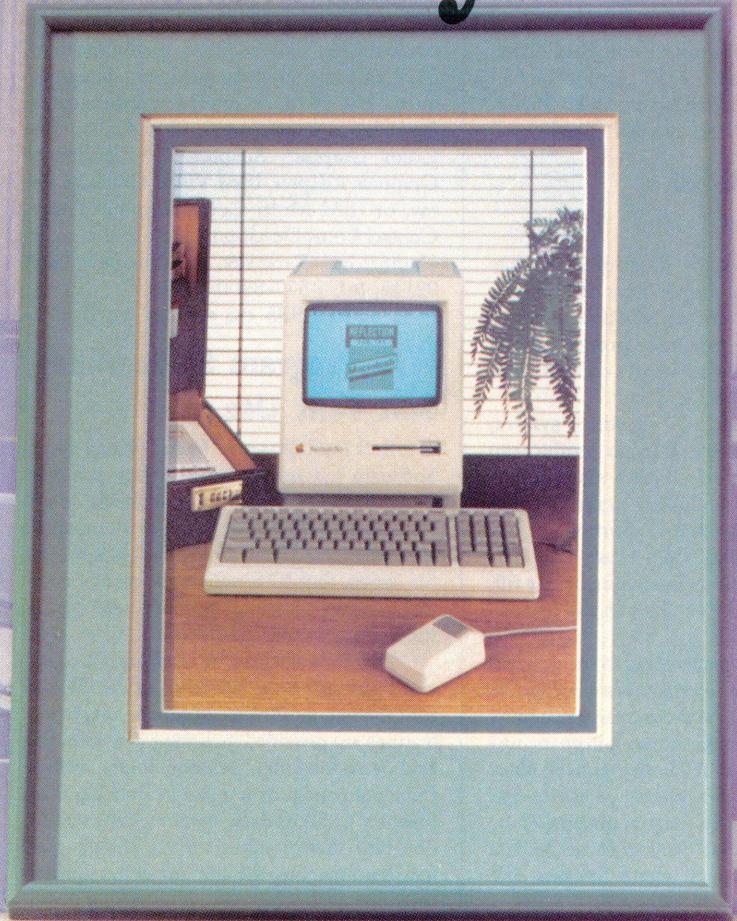
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cessing has been achieved by extensive changes to the internals of the product (up to 50 percent saving in run times).

FLEXIBASE costs from \$1900 to \$4600 dependent on HP 3000 Model. Contact Proactive Systems, Central Court, Knoll Rise, Orpington, Kent BR6 OJA, England; Tel: 0689 77933 (int: +44 689 77933); Telex: 941 3362; Fax: 0689 38702.

**Enter 924 on reader card**

## Lotus Upgrades Graphwriter

Lotus Development Corporation has announced Lotus Graphwriter II, a major upgrade of Graphwriter that offers personal computer users a system for producing and automatically updating charts created from spreadsheet or database data.

As an automated charting system, Graphwriter II allows users to produce up to 100 updated charts with a single command. Charts can be linked to files such as those from Lotus 1-2-3, Symphony, or Ashton-Tate's dBase. Then chart data, text and attributes, such as line color or bar fill, can be determined by values in the spreadsheet or database.

The major enhancements to the product include: a new user interface that employs the familiar 1-2-3 menu and command structure; direct links to any data source; automatic updating and output of charts; greater chart style control; a wider variety of charts; the ability to place multiple charts on a page; the ability to view and select data from the data source; and improved chart formats, file handling and output options.

Graphwriter II is compatible with a variety of output devices, including dot matrix and laser printers (including the HP

LaserJet, LaserJet Plus and PaintJet), plotters, color printers, and image recorder cameras. Users can produce charts for paper, 35mm slides and overhead transparencies.

Graphwriter II (\$495) runs on the IBM PC XT, AT, 3270 PC, Personal System/2, or compatibles, and requires a minimum of 512K of memory and a hard disk. It also requires one of the following graphics cards: Hercules (monochrome), IBM CGA, IBM Color Graphics Adapter, IBM Enhanced Graphics Adapter, IBM Video Graphics Array, or IBM Multi-Color Graphics Array. Contact Lotus Development Corporation, 55 Cambridge Parkway, Cambridge, MA 02142; (617) 577-8500.

**Enter 925 on reader card**

## HTS Program Streamlines Soft Font Use

The Soft Font Manager from Human Touch Software is a menu-driven utility program designed to simplify using downloadable soft fonts with Hewlett-Packard or compatible laser printers. The program replaces cryptic file names, font ID numbers and printer commands with simple cursor key selection of fonts from a font list menu.

The font list can be customized to include any soft fonts adhering to the HP soft font format. A number of font management features are provided including downloading one or more fonts, deleting fonts, making fonts permanent or temporary, making fonts primary or secondary, creating font sets for one-step downloading of frequently used fonts and tracking the amount of laser printer memory available.

In addition to the font management features, The Soft Font Manager (\$49.95) automatically configures both Microsoft

Word and WordPerfect to use any combination of soft fonts. No special formatting commands or printer codes are required.

The Soft Font Manager runs under PC-DOS or MS-DOS (version 2.0 or later) and requires an IBM PC, AT, or compatible with at least 256K of memory, two 5 1/4-inch disk drives (a hard disk is recommended), and an HP LaserJet Plus, Series II, or compatible laser printer.

Contact Human Touch Software, 8795 La Riviera Dr., Suite 100, Sacramento, CA 95826; (916) 369-1261.

**Enter 926 on reader card**

## Autodesk Ships AutoShade

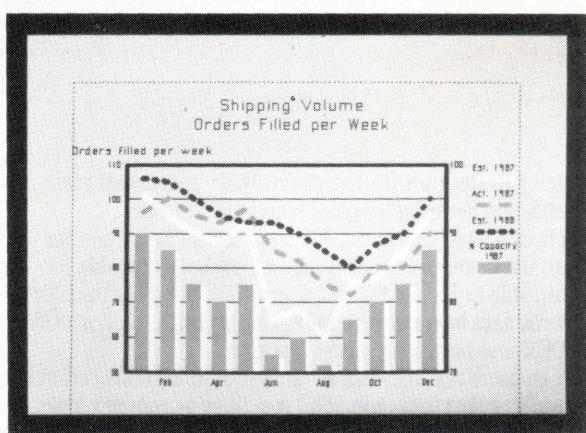
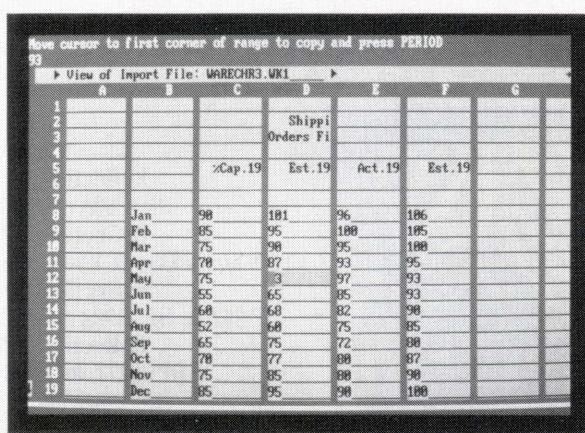
Autodesk, Inc., recently announced the shipment of AutoShade, a color rendering program that turns 3-D AutoCAD drawings into realistic, shaded images.

AutoShade (\$500) features include perspective, specular reflection and full-color hardcopy output. It accepts any drawing created using the 3-D capabilities of AutoCAD 2.6 and uses the colors of drawing elements in AutoCAD as the basis for color in the finished renderings.

The program supports systems under PC-DOS/MS-DOS, equipped with a math coprocessor. Display options include the Hercules Graphics Card in monochrome mode, the Color Graphics Adapter (CGA), the Enhanced Graphics Adapter (EGA) and the Professional Graphics Controller (PGC).

In addition to screen renderings, AutoShade also supports both monochrome and color implementations of PostScript. Contact AutoCAD at (800) 445-5415.

**Enter 927 on reader card**



Lotus' Graphwriter II permits users to view a representation of their spreadsheet and select ranges for charting (left). Changes in the data are automatically reflected in the charts each time they're printed or previewed (right).

Remember how computers remembered? Mercury delay lines? Punched cards with 90 columns and round holes? Hand-wired magnetic cores? In case your memory needs refreshing, The Computer Museum would like to share its memories with you.

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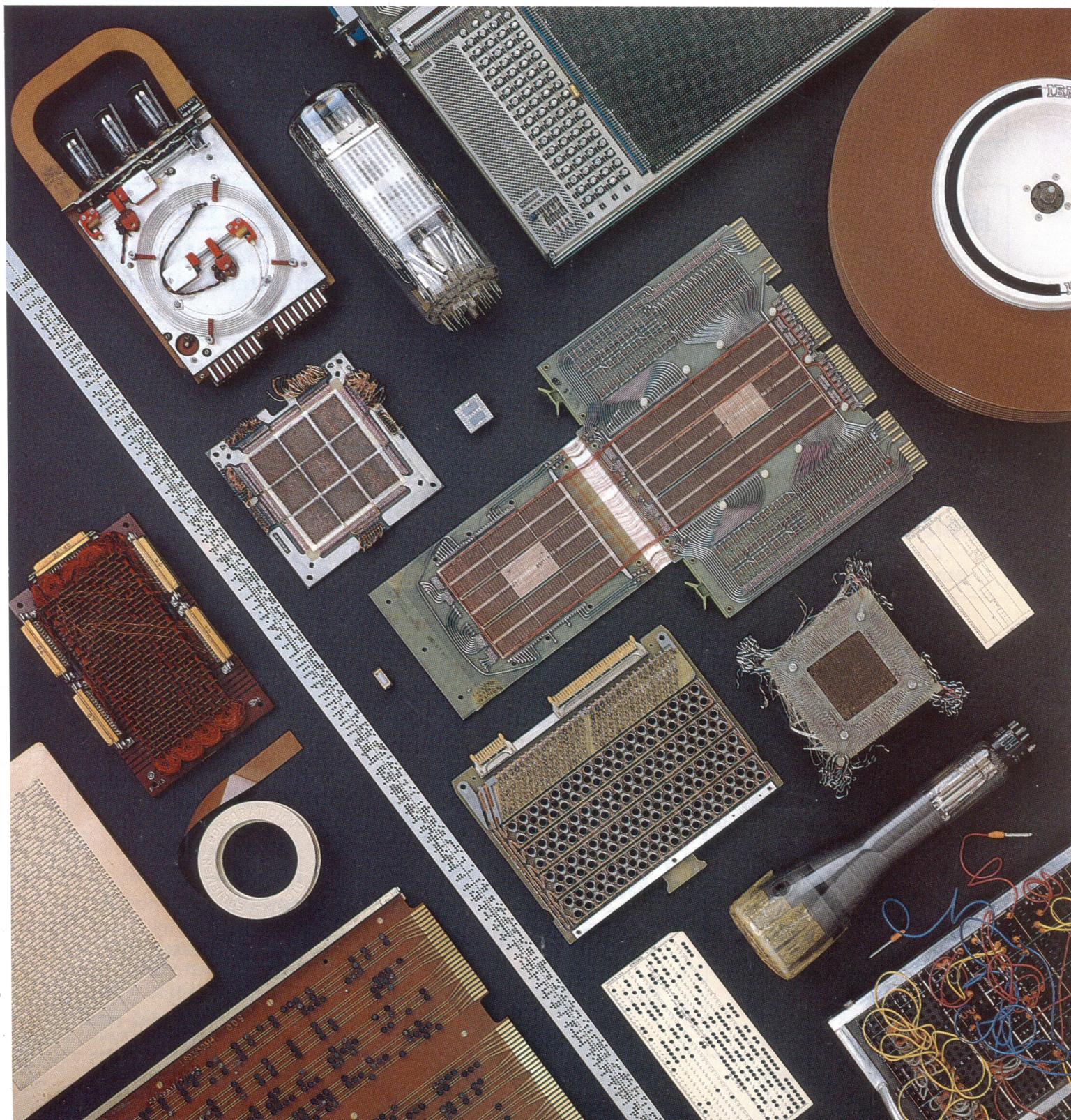


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## [ CALENDAR ]

### [ NOVEMBER ]

17-19: CAP '87 CENTRAL at the Chicago Hilton Hotel and Towers, Chicago, IL. Computer Aided Publishing, Inc. will sponsor a three-day conference focusing on electronic and desktop publishing for the business user. In addition, the conference will feature exhibits of the most important hardware and software products available in the field. For more information, contact Computer Aided Publishing, Inc., 90 West Montgomery Ave., Suite 200, Rockville, MD 20850; (301) 294-8710.

18: OKRUG (Oklahoma Regional Users Group) dinner meeting. Topic to be determined. Contact Tracey Wilson, (918) 592-0694.

18: CINMUG (Cincinnati Regional Users Group) one-day meeting, Quality Inn, I-75, Exit 192, Covington, KY. Topic: Artificial Intelligence and expert systems. Vendor display and member appreciation night. Joint meeting with the Dayton, OH (DAYMUG) and Kentucky (KYRUG) users groups. Contact Philip Landwehr, (513) 621-2850.

18: PITTRUG (Pittsburgh Regional Users Group) afternoon meeting. Contact Kevin Rump, (412) 394-5767.

19: IARUG (Iowa Regional Users Group) one-day meeting. Contact Loran Vanden Oever, (515) 628-1000.

20: AZRUG (Arizona Regional Users Group) technical seminar on programming techniques, Holiday Inn Metrocenter, Phoenix, AZ. Contact Sue Pasch, (602) 778-4130.

### [ DECEMBER ]

1: NECRUG Fourth Quarter 1987 meeting, Brandywine Sheraton, Route 202, Wilmington, DE. Topic: To be announced, plus annual business meeting. Users with voting privileges will vote for upcoming vacant board member positions. Contact Mike Granahan, (215) 768-2230 or (215) 525-8210.

9: NTRUG (North Texas Regional Users Group) meeting. Annual elections, vendor show and year-end celebration. Contact Larry Boyd, (214) 851-2984.

16: AZRUG (Arizona Regional Users Group) meeting. Subject to be announced. Contact Patty Stewart, (602) 956-6000.

### [ JANUARY 1988 ]

8: Deadline for submitting abstracts to the NECRUG Speaker Committee for presentation at the Ninth Annual Eastern American HP Users Conference, Harrah's Trump Plaza, Atlantic City, NJ, May 31-June 3, 1988. Contact NECRUG Speaker Committee, c/o John Werner, 6 Roundtree Cir., Hockessin, DE 19707.

12: GLUG (Greater Los Angeles Regional Users Group) 6 p.m. dinner meeting, at the Tea Room St. Petersburg, 8500 Beverly Blvd., Los Angeles, CA. Tickets are \$20 and include a presentation by Bob Green of Robelle Consulting, hors d'oeuvres, a Russian dinner and an informal discussion with fellow HP 3000 users. Contact Eugene Volokh at Vesoft, (213) 282-0420; Telex 181159.

21: IARUG (Iowa Regional Users Group) one-day meeting. Contact Loren Vanden Oever, (515) 628-1000.

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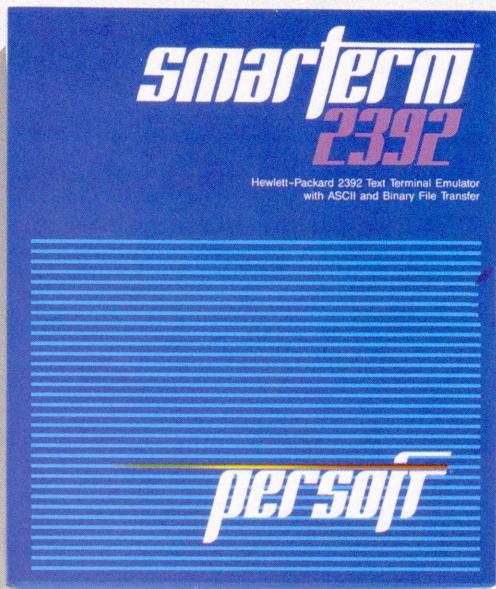
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